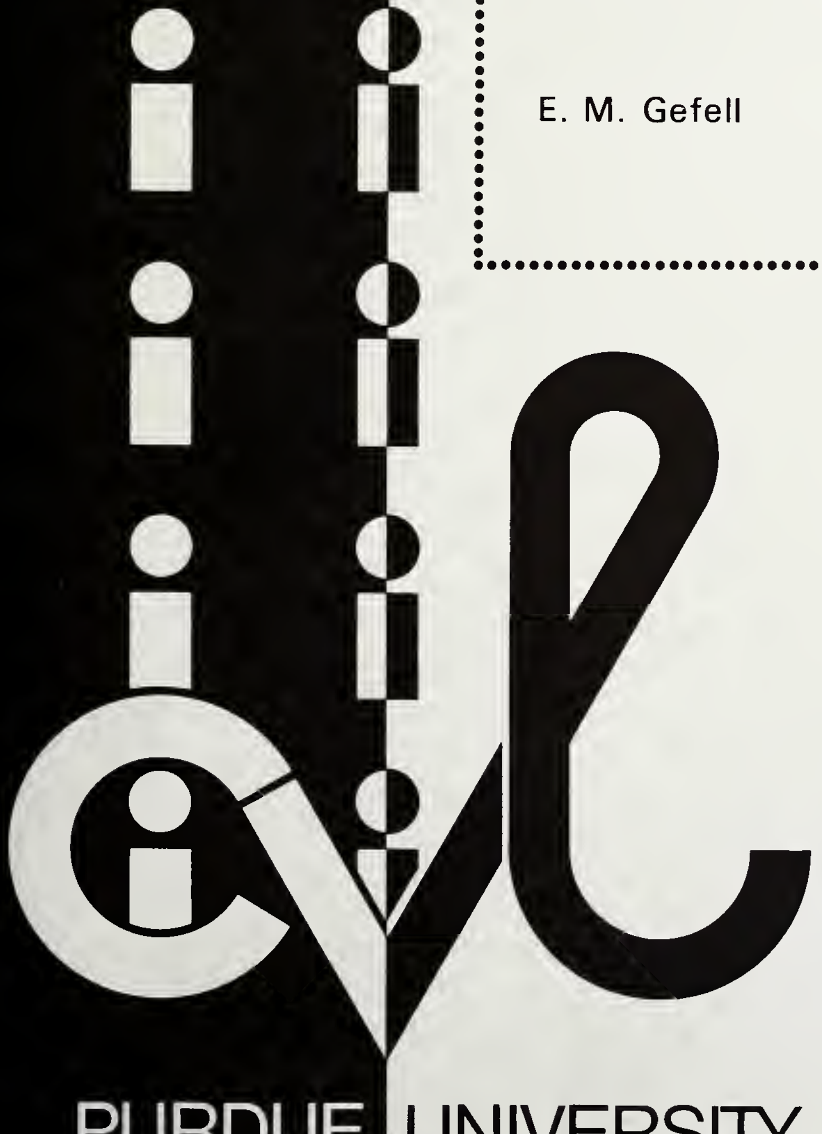
SCHOOL OF
CIVIL ENGINEERING

INDIANA
DEPARTMENT OF HIGHWAYS

JOINT HIGHWAY
RESEARCH PROJECT
JHRP-83-11

ENGINEERING SOILS MAP OF HANCOCK COUNTY, INDIANA

E. M. Gefell



PURDUE UNIVERSITY

Final Report

ENGINEERING SOILS MAP OF HANCOCK COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

FROM: Robert D. Miles

August 30, 1983

Project: C-36-51B

File: 1-5-2-71

Attached is the Final Report on the "Engineering Soils Map of Hancock County, Indiana." The soils map and report were produced by Mr. E. M. Gefell, Research Associate on our staff, under the direction of Professor Robert D. Miles.

This is the 71st county engineering soils map completed by the Airphoto Interpretation and Site Selection Laboratory. Mr. Gefell developed this map and report using aerial photographs, literature, IDOH soil borings and limited field studies. The map and report are valuable resource material for planning and development of engineered facilities in Hancock County.

The Report is presented to the Board as evidence of completion of the Hancock County engineering soils mapping project.

Sincerely,

Robert D. Miles /ms

Robert D. Miles
Research Engineer

RDM:rw

cc: A. G. Altschaeffl
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Final Report

ENGINEERING SOILS MAP OF HANCOCK COUNTY, INDIANA

by

E. M. Gefell
Research Associate

Joint Highway Research Project

Project No.: C-36-51B

File No.: 1-5-2-71

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

In Cooperation with

Indiana Department of Highways

Purdue University
West Lafayette, Indiana
August 30, 1983

ACKNOWLEDGEMENTS

The author wishes to thank Dr. D. W. Levandowski and Dr. T. R. West of the Department of Geosciences, Purdue University for their permission and recommendations for him to work on the JHRP engineering soils mapping project. He is especially grateful to Professor R. D. Miles, professor in charge, for his always enthusiastic assistance and guidance with the research, mapping, and report writing undertaken in this project. The author also wishes to recognize Rofessor H. L. Michael, Director, Joint Highway Research Project, and the other members of the JHRP Board without whose consent he would not have been allowed the privilege of working on and producing this publication.

All airphotos used in connection with the preparation of this report automatically carry the following credit line: photographed for Commodity Stabilization Service, Performance and Aerial Photography Division; United States Department of Agriculture.

Engineering Soils Map
of
Hancock County, Indiana

Introduction

The engineering soils map of Hancock County, Indiana (see Figure 1) was produced primarily by interpretation of aerial photographs. A photomosaic, shown in Figure 2, was constructed with 1939 aerial photographs and the land form - parent material associations delineated by stereoscopic inspection. Aerial photographic interpretation was done in compliance with accepted principles of observation (1)*. The aerial photographs used were taken for the U.S. Department of Agriculture and were printed at an approximate scale of 1:20,000.

The Agricultural Soil Survey of Hancock County (2) was used as a cross - reference to check soil boundaries and as a source of additional climatic, transportation, population, drainage, occupational and other data about the county. Several field trips were taken to the county to verify aerial photographic interpretations of land forms, parent materials, and surface soil textures and to resolve ambiguous details. Additional soil boundary modifications were made based on soil sampling and other field reconnaissance work. Standard symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil

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* note: numbers in parenthesis footnote references.

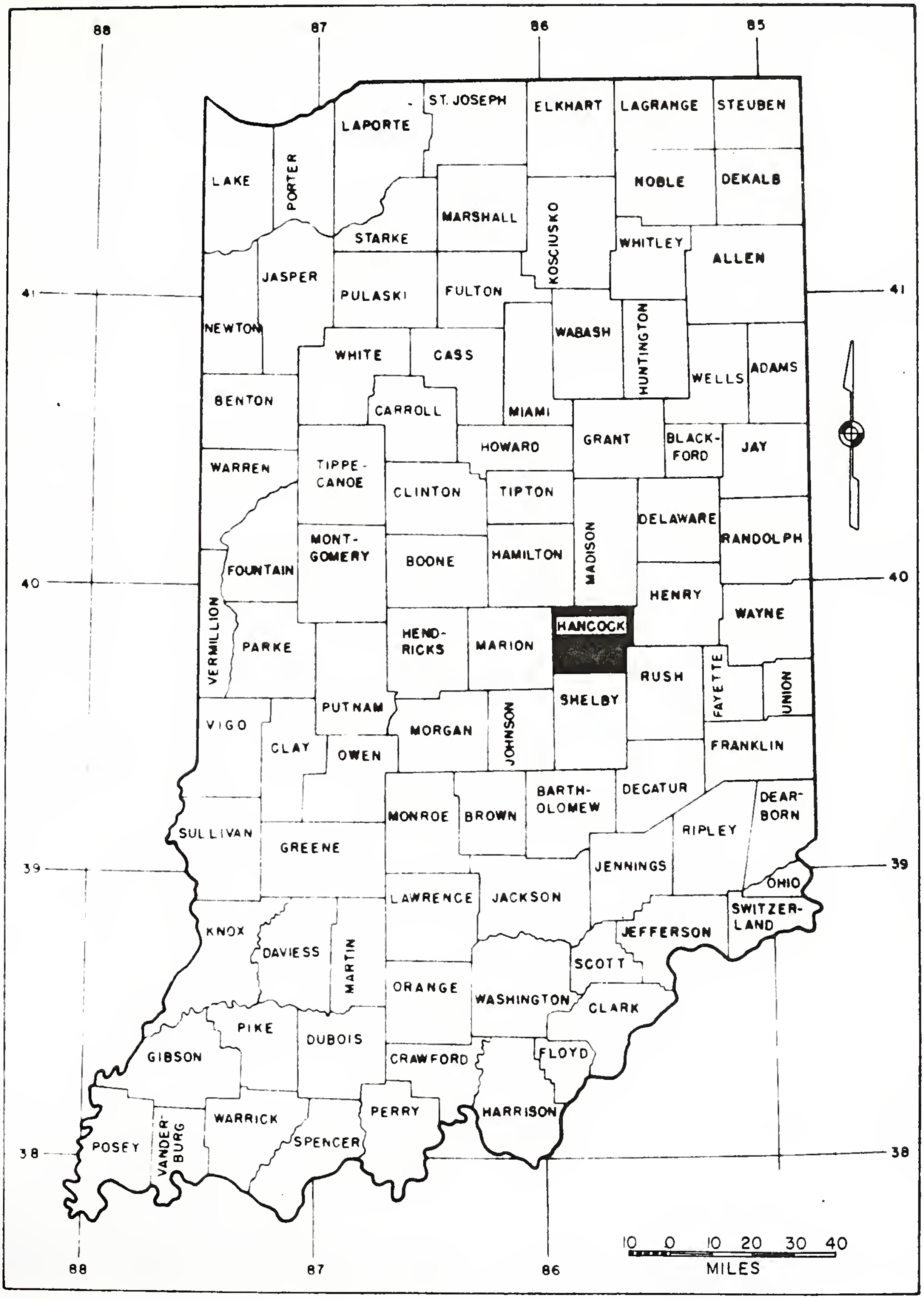


Figure 1. Location of Hancock County (2)

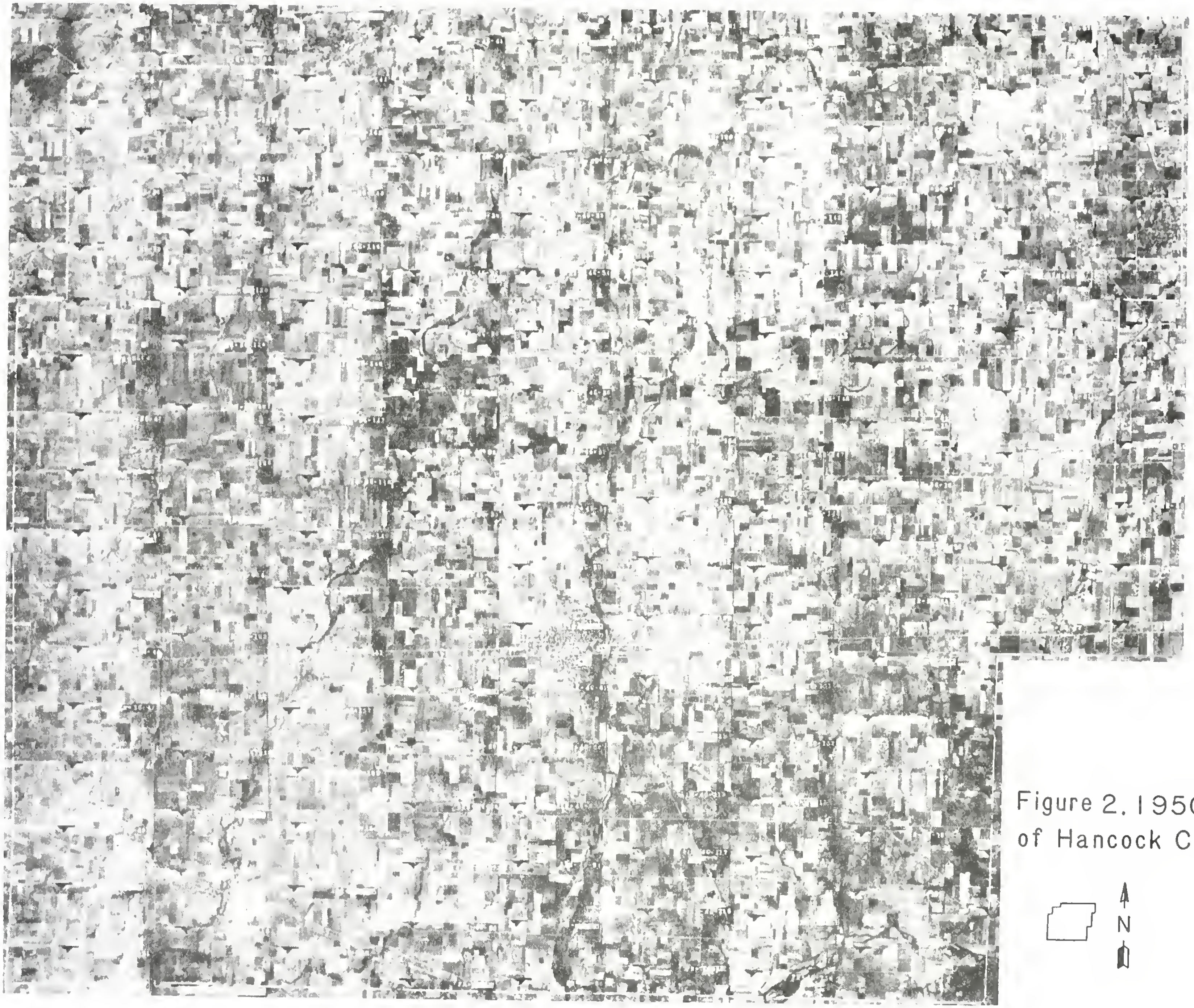


Figure 2. 1950 Photomosai
of Hancock County, Indiana

Engineering, Purdue University were used to identify the land form - parent material associations, surface soil textures, and other miscellaneous areas (eg., gravel pits, lakes and ponds, etc.) on the engineering soils map. The map and report were part of an on - going effort to complete a comprehensive, county by county engineering soils survey of the State of Indiana using a standard set of symbols. All map units of any given county were to correlate with those of all adjacent counties. In some places, this author´s interpretations of land forms and parent materials did not match exactly with the interpretations of others. Where these disparities occurred, every effort was made to maintain the continuity of the soil units in question in the transitional zone near the county lines.

The county drainage maps were generally used to make the engineering soil base maps. However, due to discrepencies found between the Hancock County Drainage Map and adjacent completed engineering soil maps (due to shrinkage and stretching of the original cloth copy) the recent General Highway and Transportation Map of Hancock County (1978) was used as a base instead.

Description of The Area

General

Hancock County is located in east - central Indiana and is basicly rectangular in shape, being offset somewhat to the east in the northern half in a right angle, stair - step manner (see Figure 1). Hancock County is bordered on the west by Marion

County, to the north by Hamilton and Madison Counties, to the east by Henry and Rush Counties, and to the south by Shelby County. It has an area of approximately 195,000 acres or 307 square miles (2), with a maximum north - south distance of 17 miles and a maximum east - west distance of about 19.5 miles. The City of Greenfield, located in south - central Hancock County about 20 miles east of Indianapolis, is the seat of government. The City of Fortville, located about 11.5 miles north - northwest of Greenfield, and Cumberland, located approximately 10.0 miles to the west are the other major centers of population in the county. Other smaller towns or cities include New Palestine, Philadelphia, McCordsville, Shirley, and Charlottesville. Total county population according to the 1980 census is 43,939, of which 27,777 lived in areas classified as rural (3). Population data for the townships and major urban areas in the county are shown in Table 1.

Table 1. 1980 Population Data For Hancock County (3).

City	Population
Fortville	2,787
Cumberland	3,375
Greenfield	11,439
Township	
Blue River	1,201
Brandywine	1,658
Brown	2,703
Buck Creek	4,675
Center	16,135
Green	1,686
Jackson	1,884
Sugar Creek	8,114
Vernon	5,884

Table 2 shows the population growth for Hancock County and the City of Greenfield between 1830 and 1980.

Table 2. Population Growth Of Hancock County, (1830 - 1980)(4).

Year	Hancock Cty.	Greenfield	Year	Hancock Cty.	Greenfield
1830	1,436		1910	19,030	4,448
1840	7,535		1920	17,210	4,168
1850	9,698		1930	16,605	4,188
1860	12,802		1940	17,303	4,821
1870	15,123		1950	20,332	6,159
1880	17,123		1960	26,665	9,049
1890	17,829	3,100	1970	35,096	9,986
1900	19,189	4,489	1980	43,939 (3)	11,439 (3)

Hancock County is served by both road and railway transportation facilities. Several railway lines cross the county, providing railway links to nearly anywhere in North America outside the county. The major east - west roadways in the county are I - 70 and US 40. US 52 crosses the southwest corner of the county and US 36 crosses the northwest corner of the county. SR 9 carries the bulk of the north - south traffic. Small airports are located at Greenfield and McCordsville, and a larger facility is located near Mt. Comfort (2). Additional smaller landing strips are found scattered throughout the county.

Most of the land in Hancock County was in agricultural use in 1979 (5). Urban and forested land comprised most of the remainder of the county. Table 3 shows 1979 land use distribution as determined by the Indiana State Services Planning Agency.

Table 3. 1979 Land Use Data For Hancock County (5).

Land Use	Acres
Agricultural	181,090
Forest	10,230
Urban	8,670
Water	390
Barren	100
Other	360
	200,840 total.

Agriculture was the largest industry in Hancock County (2). There were no major heavy industries, however, many residents worked in factories and other businesses in Indianapolis and Anderson. A pharmacology research company located just west of Greenfield was the largest single industrial employer in Hancock County. Hogs were the main livestock raised, followed by feeder and dairy cattle.

Most of the water used for industrial and municipal purposes in Hancock County was obtained from water wells which intersected sand and gravel layers in the glacial drift (4). Few wells exceeded 150 feet in depth and yields of 750 gpm were common. The maximum recorded yield in the county as of 1975 was 1,000 gpm from wells near Greenfield. Wells which penetrated bedrock had

maximum yields of approximately 100 gpm. Bedrock of Devonian age generally out - produced formations of Silurian age. Surface water was used only nominally as of 1975 (4).

Climate

Hancock County, Indiana had a humid continental climate and was on the fringe of the area whose weather was influenced by the Great Lakes (2). Cool, Canadian air masses alternated with tropical air masses from the south providing the area with an invigorating and variable climate. Seasonal temperature changes were moderate, while extreme temperature fluctuations on a day - to - day basis were not uncommon. Climatological data recorded at the Greenfield weather station between 1934 and 1963 are shown in Table 4.

A record high of 109° F was set at the Greenfield weather station in July, 1936 (6). The lowest temperature recorded was -18° F in January, 1963. The mercury rose above 90° an average of 34 days every year and remained below freezing an average of 28 days per year.

Precipitation was rather evenly distributed throughout the year, although that which occurred during the spring and early summer generally exceeded that which fell in the fall and winter months. Average annual precipitation was 38.39 inches (6). The probability of unusually heavy rains occurring in short periods of time is shown in Table 4. Snowfall generally averaged about 22

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
IN COOPERATION WITH PURDUE AGRICULTURAL EXPERIMENT STATION
CLIMATOGRAPHY OF THE UNITED STATES NO 20 — 12

LATITUDE 39° 47' N.
LONGITUDE 85° 46' W.
ELEV. (GROUND) 900 Ft.

TABLE 4. CLIMATOLOGICAL SUMMARY (6)

STATION GREENFIELD, INDIANA

MEANS AND EXTREMES FOR PERIOD 1934-1963

Month	Temperature (°F)							Mean degree days **	Precipitation Totals (Inches)								Mean number of days					Month
	Means			Extremes								Snow, Sleet					Precip. .10 inch or more	Temperatures				
																		Max.		Min.		
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year		Mean	Greatest daily	Year	Mean	Maximum monthly	Year	Greatest daily	Year		90° and above	32° and below	32° and below	0° and below	
(a)	30	30		30		30		30	30	30		30	30		30		10	27	27	27	27	
Jan.	38.0	21.2	29.6	72	1943	-18	1963+	1076	2.90	3.36	1937	5.4	13.0	1956	7.0	1939	5	0	9	27	2	Jan.
Feb.	40.9	23.0	32.0	69	1954+	-16	1951	913	2.29	2.07	1950	5.0	15.0	1962	7.0	1961	5	0	7	24	1	Feb.
Mar.	50.6	30.4	40.5	85	1938	-6	1943	769	3.55	2.20	1938	4.9	16.0	1960	8.0	1949	6	0	2	19	*	Mar.
Apr.	62.9	40.8	51.9	89	1942	17	1950	393	3.66	3.03	1948	T	5.5	1957	5.0	1957	8	0	0	6	0	Apr.
May	74.3	51.3	62.8	96	1934	27	1947	149	4.59	2.87	1942	T	T	1950	T	1950	9	1	0	*	0	May
June	83.5	60.8	72.2	104	1934	38	1945	21	4.30	2.50	1958	0	0		0		6	9	0	0	0	June
July	87.5	64.1	75.8	109	1936	45	1942	0	3.82	2.53	1935	0	0		0		8	11	0	0	0	July
Aug.	86.0	62.5	74.3	104	1936	41	1946	6	2.74	2.46	1958	0	0		0		6	9	0	0	0	Aug.
Sept	79.6	55.2	67.4	103	1939	26	1942	75	3.14	3.72	1955	0	0		0		5	4	0	*	0	Sept.
Oct.	68.1	44.2	56.2	91	1951	20	1952+	298	2.41	2.75	1959	T	T	1962+	T	1962+	5	*	0	3	0	Oct.
Nov.	51.2	32.6	41.9	81	1950	-2	1950	687	2.82	3.60	1955	1.9	8.5	1950	4.0	1958+	5	0	2	16	*	Nov.
Dec.	39.8	23.5	31.7	69	1951	-14	1950	1017	2.17	1.53	1956	5.6	14.3	1935	6.5	1945	4	0	8	25	1	Dec.
Year	63.5	42.5	53.0	109	July 1936	-18	Jan. 1936	5404	38.39	3.72	Sept. 1955	21.6	16.0	Mar. 1960	8.0	Mar. 1949	72	34	28	120	4	Year

(a) Average length of record, years.

T Trace, an amount too small to measure.

** Base 65°F

+ Also on earlier dates, months, or years.

* Less than one half.

CLIMATE OF GREENFIELD, INDIANA

Greenfield, located in Hancock County in Central Indiana, has an invigorating climate because of the frequent changes of the weather. Pleasant, cloudless days are interspersed with some rainy days throughout the year. Monsoon rains are unknown but rainfall is usually adequate in all seasons favoring a diversified agriculture. In the summer when moisture utilization is high, a dry month of below normal rainfall affects lawns, pastures, and crops.

Weather changes every few days come from the passing of weather fronts and associated centers of low and high air pressure. In general, a high brings lower temperatures, lower humidity and sunny days. An approaching low brings increasing temperatures, increasing southerly wind, higher humidity, and commencement of rain or showers. This activity is greatest in the spring and least in late summer and early fall.

Precipitation is rather evenly distributed throughout the year, a happy contrast to some areas of the United States that have a "dry season" and require irrigation to maintain green vegetation. The table of monthly rainfall for past years in this report shows the variation of rainfall that may be expected. There is a tendency for spring and early summer rains to exceed winter precipitation. The spring rains are very reliable insuring near maximum soil moisture going into summer when evaporation losses exceed rainfall and dry soils become more probable. A severe drought has never been experienced. About one-third of the annual rainfall flows into streams and out of the area. Future needs may require conservation of this water.

The probability for unusually heavy rains in just a few hours is indicated by a weather study of the area:

Frequency in 100 years	Rain in 1 hour	6 hours	12 hours
4	2.4	4.0	4.6
10	2.1	3.3	3.8
20	1.7	2.8	3.2

Snowfall has varied reception. None occurs in the summer. Some winters have much snow and others have very little. An occasional snow storm may hamper travel and clog roads but at the same time the snow blanket protects winter grains from the very cold air that invariably follows. Heaviest snow storms are those out of the southwest. As they swirl northeastward, abundant moisture flows in from the Gulf of Mexico. A storm out of the northwest, with an inward flow of colder, drier air, leaves less snow. Some mid-winters are thus cold but snowfall is normal or less.

Relative humidity is not measured at this station but estimates are possible from the climatology of the area. Relative humidity varies on sunny summer days from a percent in the 40's in the early afternoon to the 90's about sunrise. Relative humidity rises and falls much as temperature does during a typical day but the highest percent usually occurs with the minimum temperature and the lowest percent with the maximum temperature. A cold front is next in importance in changing relative humidity downward.

Winds blow most frequently from the southwest, however, in one or two of the winter months, prevailing winds are northwest. Damaging winds have three sources. In the order of diminishing areal coverage but increasing intensity, they are: lows passing through the region, thunderstorms, and tornadoes. Only 9 tornadoes have been reported in the county since 1916. Very few were of sufficient size to injure people and property. Thunderstorms, including incidences of lightning and thunder, occur about 47 days of the year. Most of these occur in the spring and early summer. They are seldom so severe as to cause loss of life, property, or crops. Death dealing smog or fog is unknown.

Heating degree days in the above table provide a comparative number for calculating heating requirements between different places and different times. Fuel consumption for heating is proportional to degree day totals, so a month with twice the heating degree days of another month requires twice as much fuel for heating. Degree days for a single day are obtained by subtracting the mean temperature from 65 degrees.

The growing season (defined here as the number of days between the last spring and first fall temperature of 32°) averages 171 days in length. The season is 193 days or more in 10% of the years, 182 days or more in 25% of the years, less than 160 days in 25% of the years, and less than 149 days in 10% of the years.

Many days of the year are nearly ideal in temperature. A few days, in the summer when temperatures exceed 90, or decline below zero in the winter, tend to obscure this fact. The fall season is considered by many as the best time of year for outdoor activities. Spring is also a favorite season but actually this season has more days of rain and thunderstorms. In the fall the atmosphere in total seems more quiet. Air and soil temperatures are nearer in agreement than any other time of the year, thus, convective activity is diminished. Many days are sunny and showers are less frequent.

Laurence A. Schaal
Weather Bureau State Climatologist
Purdue University, Agronomy Department
Lafayette, Indiana

Table 4, continued.

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1934	33.7	23.8	37.4	52.0	67.1	78.5	81.2	74.6	67.8	57.8	47.4	30.0	54.3
1935	31.1	34.8	48.5	49.5	58.2	68.6	78.0	75.8	67.0	56.2	43.2	25.6	53.0
1936	22.8	22.7	44.7	47.4	66.0	73.0	82.7	80.1	71.0	54.9	38.6	35.6	53.3
1937	34.0	30.9	36.4	52.6	61.7	70.4	75.5	76.9	64.4	53.3	39.0	29.0	52.0
1938	30.0	39.2	47.6	54.2	62.8	69.9	76.2	76.4	68.8	59.2	44.8	33.2	55.2
1939	33.8	31.6	42.2	47.6	64.6	73.4	74.0	71.8	71.2	55.4	36.9	34.8	53.2
1940	16.2	32.1	38.2	49.1	59.0	70.6	74.8	75.0	64.6	58.0	39.8	37.2	51.2
1941	29.8	27.0	35.0	56.5	65.1	71.5	76.2	73.9	70.0	58.6	42.8	37.1	53.6
1942	28.4	27.2	42.4	55.2	63.3	71.8	76.3	72.6	64.6	55.4	44.4	27.4	52.4
1943	29.4	32.6	36.8	48.4	62.2	75.7	75.9	75.0	63.2	53.8	39.8	30.2	51.9
1944	33.4	34.3	38.6	51.0	68.8	76.0	76.6	75.1	66.9	54.8	43.8	27.0	53.8
1945	23.2	32.2	52.4	53.7	57.6	69.4	72.6	72.5	68.5	53.0	43.8	25.0	52.0
1946	30.8	34.4	52.4	53.5	59.9	71.6	75.2	69.6	67.0	59.5	46.8	36.6	54.8
1947	34.4	24.2	34.1	51.8	59.7	69.4	71.6	80.0	67.9	62.5	39.0	32.4	52.2
1948	22.6	32.0	42.7	56.1	61.7	72.6	75.7	73.6	68.0	52.0	46.9	35.4	53.3
1949	35.4	36.8	42.8	51.3	64.3	74.2	78.9	74.5	61.4	59.8	43.7	36.6	54.9
1950	38.6	33.1	38.0	47.0	64.1	69.7	72.4	70.7	65.0	59.8	37.3	24.5	51.7
1951	31.2	31.7	39.7	49.9	64.9	70.9	74.7	73.5	65.0	58.9	36.7	32.1	52.4
1952	34.4	36.9	40.8	53.2	62.3	77.3	78.1	73.2	66.2	51.3	44.3	35.6	54.5
1953	34.4	37.3	43.5	49.0	65.5	76.0	75.8	74.5	68.6	58.7	44.5	34.1	55.1
1954	32.6	40.9	39.4	58.9	58.4	75.9	78.4	74.6	71.3	56.4	43.2	33.3	55.3
1955	28.8	33.1	43.8	59.3	65.0	67.8	78.9	76.4	70.3	56.5	40.1	30.2	54.2
1956	28.3	35.6	41.8	51.1	64.0	72.5	-	73.4	63.7	59.6	41.3	37.5	-
1957	22.4	35.7	39.4	52.7	61.6	71.7	75.1	73.0	64.5	50.9	41.6	34.7	52.0
1958	27.2	23.4	35.2	52.0	60.4	66.5	73.2	71.6	64.7	53.9	43.9	22.8	49.6
1959	24.4	31.0	37.3	52.0	65.9	72.3	74.7	77.2	68.3	53.7	37.0	35.7	52.5
1960	30.8	27.8	25.1	54.3	59.4	68.7	72.0	73.9	70.1	54.2	43.2	24.4	50.3
1961	24.4	34.3	42.7	45.4	56.9	69.0	74.3	72.7	70.7	56.5	42.3	29.7	51.6
1962	23.9	28.9	36.2	49.7	68.5	72.1	72.5	71.6	62.5	56.5	41.7	26.0	50.8
1963	19.0	20.1	41.7	51.6	58.6	70.8	73.3	69.2	65.7	61.2	44.8	19.7	49.6
1964	29.8	28.3	39.0	53.0	65.1								

Total Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1934	1.34	0.73	3.05	1.25	0.85	2.96	2.80	2.12	4.24	0.26	1.56	1.64	22.80
1935	2.03	0.24	3.07	1.35	7.87	4.24	8.70	2.14	4.39	1.69	3.75	2.23	41.70
1936	1.43	3.11	2.96	3.92	1.17	1.10	0.43	2.82	6.35	3.21	4.12	2.44	33.06
1937	9.49	1.94	1.45	3.74	2.89	4.23	3.27	3.73	3.40	4.47	1.30	3.35	43.26
1938	1.06	2.72	8.38	3.12	7.91	6.81	4.13	3.75	2.55	0.93	3.75	1.20	46.33
1939	4.95	3.82	3.60	6.70	2.65	5.17	5.80	2.55	1.05	2.60	1.42	1.13	41.44
1940	1.44	2.34	1.25	6.01	4.20	2.38	1.21	1.33	0.60	1.44	3.31	2.29	27.80
1941	1.38	0.64	1.04	1.64	0.82	5.44	1.96	1.77	1.53	9.25	2.57	1.58	29.62
1942	0.80	4.00	4.87	2.69	6.07	7.06	1.54	5.48	2.76	1.18	4.58	2.59	43.62
1943	0.94	2.14	4.58	2.32	8.12	5.30	6.27	0.79	3.56	1.80	1.82	0.82	38.46
1944	0.29	2.75	5.12	7.74	2.34	1.98	1.73	2.55	2.28	0.62	2.94	1.68	32.02
1945	0.88	2.92	6.95	5.36	3.20	7.06	4.01	3.03	5.40	1.61	3.72	2.68	46.82
1946	1.09	2.67	3.82	1.32	8.38	3.52	2.60	3.29	0.96	2.60	3.23	3.02	36.50
1947	4.59	0.37	2.12	6.19	3.89	4.40	6.80	3.61	3.42	2.65	1.33	1.72	41.09
1948	2.65	2.51	5.99	5.08	3.81	5.09	3.08	1.24	2.55	3.96	4.80	2.52	42.68
1949	6.66	2.64	3.61	1.86	3.23	4.57	3.24	2.10	3.25	3.24	0.58	3.07	38.05
1950	11.54	5.69	3.59	3.85	4.20	6.85	3.06	2.81	5.61	1.14	5.12	2.53	55.99
1951	3.03	3.25	3.28	3.57	4.44	5.62	3.02	1.25	1.65	1.11	4.52	4.46	39.20
1952	3.86	2.58	4.87	3.89	2.86	6.02	2.56	2.70	6.34	0.59	2.95	2.29	41.51
1953	2.19	1.51	4.28	2.46	4.97	3.43	4.32	2.80	1.37	1.24	1.56	2.37	32.50
1954	3.63	2.37	2.67	4.55	2.82	1.17	1.48	5.05	1.13	5.97	1.12	1.89	33.85
1955	2.06	1.95	2.93	4.00	4.41	3.95	5.50	2.49	8.19	3.00	6.04	0.37	44.89
1956	1.58	2.92	2.05	3.09	9.40	1.54	3.53	3.04	1.05	0.43	1.61	3.43	33.67
1957	1.92	1.44	1.68	5.73	6.63	6.51	2.18	3.54	2.26	2.91	2.53	4.51	41.84
1958	1.50	0.36	1.15	2.92	4.35	10.93	9.29	4.46	3.90	2.47	4.44	0.16	45.93
1959	4.88	1.97	2.17	4.26	5.05	1.27	3.96	1.68	1.59	5.26	3.07	2.02	37.18
1960	2.21	3.02	1.00	1.12	4.86	4.87	4.00	2.33	2.20	1.45	1.29	1.56	29.91
1961	0.97	2.54	4.75	5.99	4.85	3.11	5.17	2.39	3.05	2.31	3.05	2.88	41.06
1962	3.88	2.22	3.32	0.82	3.92	0.82	7.59	4.21	2.64	1.83	1.68	0.70	33.63
1963	0.80	0.69	8.13	4.28	2.96	1.99	3.95	2.16	0.20	0.27	2.52	0.70	28.65
1964	1.44	2.52	7.37	8.66	1.00								

STATION HISTORY

This study of local climate is possible because citizens of the community for many years generously donated a few minutes a day, seven days a week, reading and recording weather information form government instruments. The Greenfield weather station has been located at the U. S. Post Office since June 1, 1940, where William Harbaugh was observer until his retirement on October 15, 1963. Charles B. Sharp is presently taking observations. Earlier observers, dates of service, and direction of station from the post office are: S. S. Boots, February 1, 1887 to August 31, 1887; A. P. Boots, September 1, 1887 to October 31, 1887; W. C. Goble, November 1, 1903 to June 30, 1911; Frank Larrabee, July 1, 1911 to June 30, 1919, on high school grounds at North and Pennsylvania Streets; F. A. Miller, November 17, 1919 to June 8, 1926, 1/2 to 3/4 mile west; John S. Souder, June 8, 1926 to June 1, 1940, 2 blocks south and 4 blocks east.

EXTREMES AND DATES OF OCCURRENCE (1903-1963)

Month	Highest Temperature		Lowest Temperature		Greatest Daily Precipitation		Greatest Monthly Snowfall	
Jan.	72	1/24/43	-21	1/18/30	3.36	1/14/37	21.5	1915
Feb.	70	2/22/22+	-16	2/2/51+	2.07	2/13/50	21.5	1910
Mar.	85	3/22/38	-6	3/8/43	2.85	3/14/22	31.5	1906
Apr.	91	4/25/25	16	4/1/23	3.10	4/14/22	5.5	1957
May	96	5/31/34	27	5/9/47+	2.87	5/4/42	T	1950
June	104	6/28/34	38	6/5/45	4.44	6/27/32		
July	109	7/11/36	45	7/7/42	4.51	7/8/15		
Aug.	104	8/22/36+	40	8/31/15	3.91	8/12/26		
Sept.	103	9/14/39	24	9/26/28	3.72	9/23/55		
Oct.	91	10/4/51+	15	10/29/25	2.80	10/6/10	2.5	1917
Nov.	[illegible]	11/1/50	-2	11/25/50+	3.60	11/16/55	9.6	1932
Dec.	69	12/31/51	-18	12/28/24	2.15	12/11/31	14.3	1935

PROBABILITY OF LOW TEMPERATURES IN SPRING AND FALL

Minimum Temp.	Percent of occurrence after the date in spring					Percent of occurrence before the date in fall				
	90%	75%	50%	25%	10%	10%	25%	50%	75%	90%
40	5/8	5/14	5/20	5/26	6/1	9/15	9/21	9/28	10/5	10/11
36	4/26	5/3	5/11	5/19	5/26	9/21	9/27	10/4	10/11	10/17
32	4/13	4/20	4/27	5/4	5/11	9/30	10/8	10/16	10/24	11/1
28	3/28	4/5	4/14	4/23	5/1	10/13	10/21	10/29	11/6	11/14
24	3/12	3/21	3/30	4/8	4/17	10/22	10/29	11/6	11/14	11/21
20	2/24	3/5	3/14	3/23	4/1	11/5	11/12	11/20	11/28	12/5
16	2/14	2/23	3/5	3/15	3/24	11/9	11/20	12/2	12/14	12/25

This table summarizes for a 30-year period the dates when low temperatures such as 32°F. last occurred in the spring and first occurred in the fall. The average date is given in the 50% column. The table shows that the last temperature of 32° or lower in the spring occurs after May 4 in 25% of the years, and before October 8 in the fall. Probabilities for other temperatures are indicated. Reference: "Risks of Freezing Temperatures--Spring and Fall in Indiana," by L. A. Schaal, J. E. Newman, F. H. Emerson.

inches per year. The heaviest single day snowfall was eight inches recorded on March 10, 1949.

Winds ordinarily blew from the southwest, however, northwesterly winds sometimes prevailed in one or two months of the winter. Wind speeds 20 feet above the ground surface averaged approximately 7.0 mph during September and about 11.0 mph during winter and early spring.

Drainage

Hancock County lies entirely within the White River drainage basin of the State of Indiana (7). The northwest corner of the county lies in the White River basin proper while the rest of the county lies in the East Fork subdivision of that drainage system.

Locally, drainage was sub - parallel with the water flowing toward the southwest in a regionally dendritic pattern (see Figure 3). Preglacial rivers drained to the west in bedrock valleys (see Figure 4). Sugar and Brandywine Creeks flowed to the west in the northern half of the county before turning southwestward, apparently due to a broad band of ridge moraine located in the eastern half of the county. Clusters of infiltration basins and scattered kettles were common in areas of ridge moraine, some associated with deposits of peat and muck.

Several glacial sluiceways formed by the meltwaters of the Wisconsinan glaciation transected areas of ridge and ground moraine. The most prominent of these was associated with the

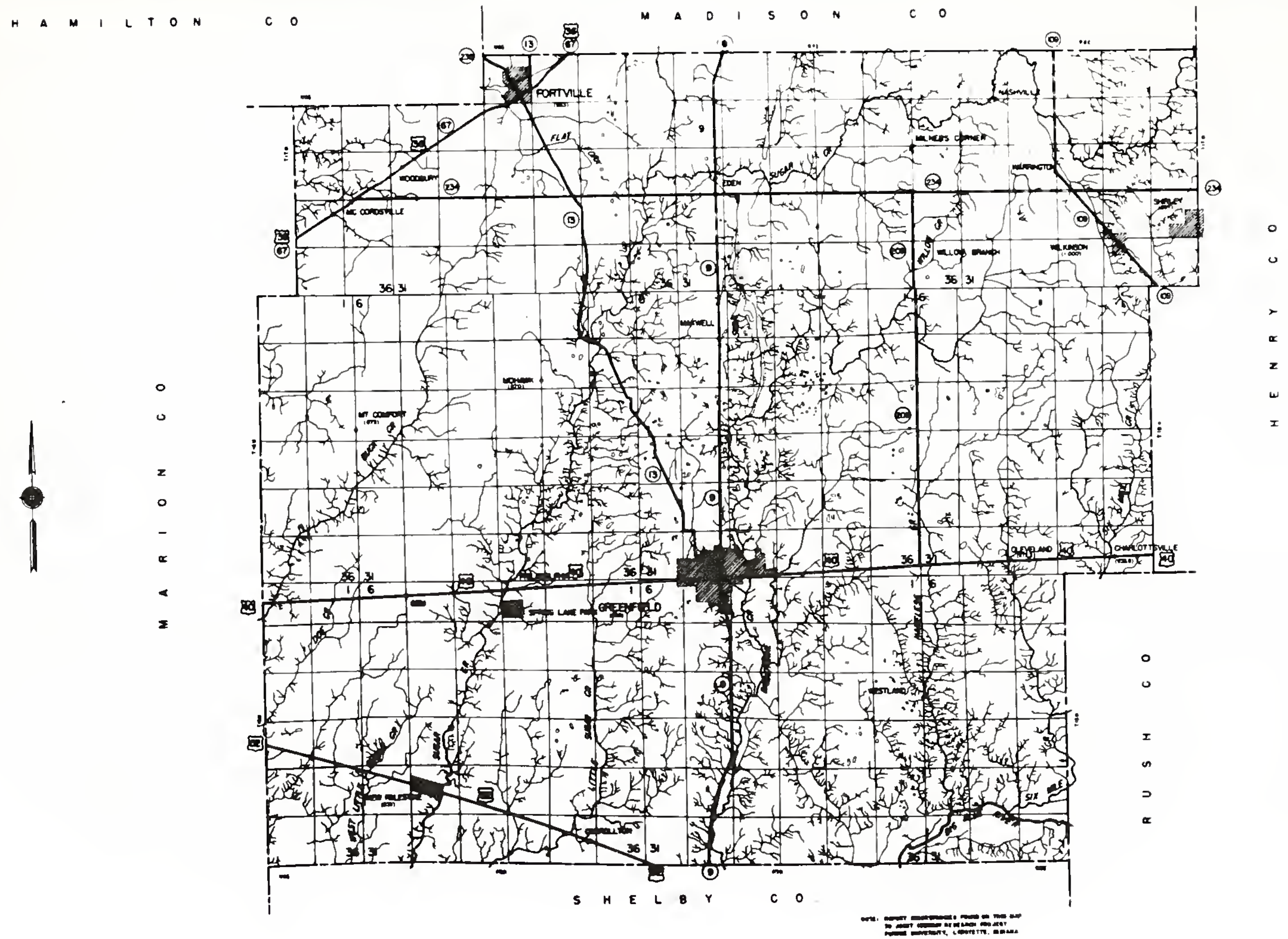


Figure 3. DRAINAGE MAP HANCOCK COUNTY (7) INDIANA

PREPARED FROM
1939 AAA AERIAL PHOTOGRAPHS
BY
STATE HIGHWAY COMMISSION OF INDIANA
AT
PURDUE UNIVERSITY
1948

SCALE OF MILES

POLYCONIC PROJECTION

PREPARED UNDER THE SUPERVISION OF [illegible]

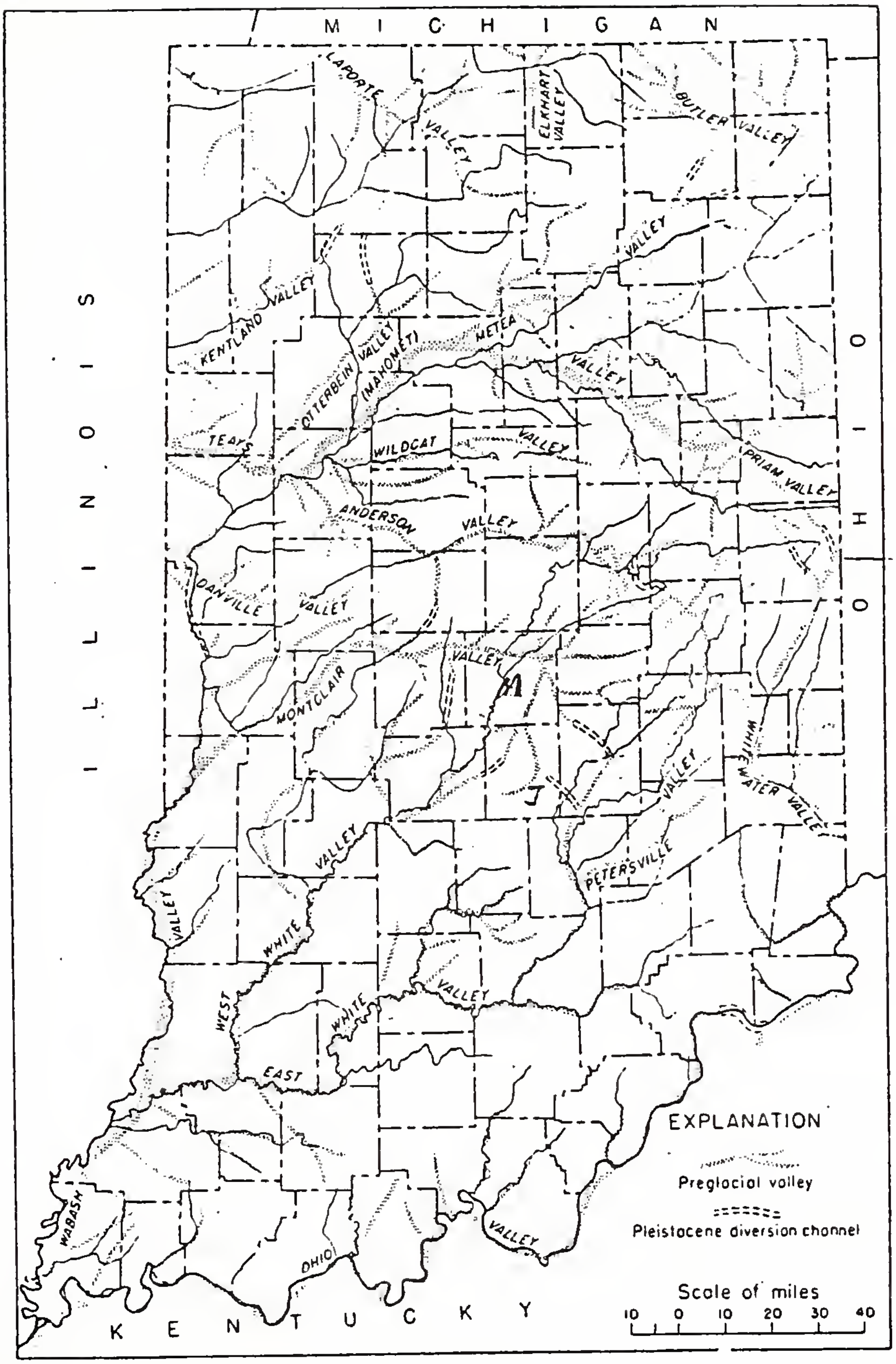


Figure 4. Map Showing Preglacial Bedrock Valleys and Present Drainage System (21)

present-day watercourse of Brandywine Creek. Some of the glacial sluiceways were occupied by underfit streams while others were apparently not drained. In some cases, water drained in opposite directions from a high point within a sluiceway (7).

The degradational processes of the Blue River and Brandywine and Sugar Creeks resulted in some of the most prominent relief found in the county. The Blue River was entrenched by the action of Wisconsinan glacial meltwater and was subsequently partially filled by outwash sediments (4). The other large streams in the county, particularly Sugar and Brandywine Creeks, underwent a similar process but on a smaller scale.

No natural lakes were found in the county , however, man - made and natural ponds were found scattered throughout the area (7). Numerous ditches were excavated and several streams dredged to improve drainage conditions and free low - lying areas of standing water. Flooding was not uncommon along major streams, and depressions in the ridge and ground moraine were commonly subjected to seasonal flooding (ie., during the spring).

Physiography

Hancock County is located in the Till Plains section of the Central Lowlands physiographic province of the United States (8). It is located in the Tipton Till Plains region of the State of Indiana (see Figure 5).

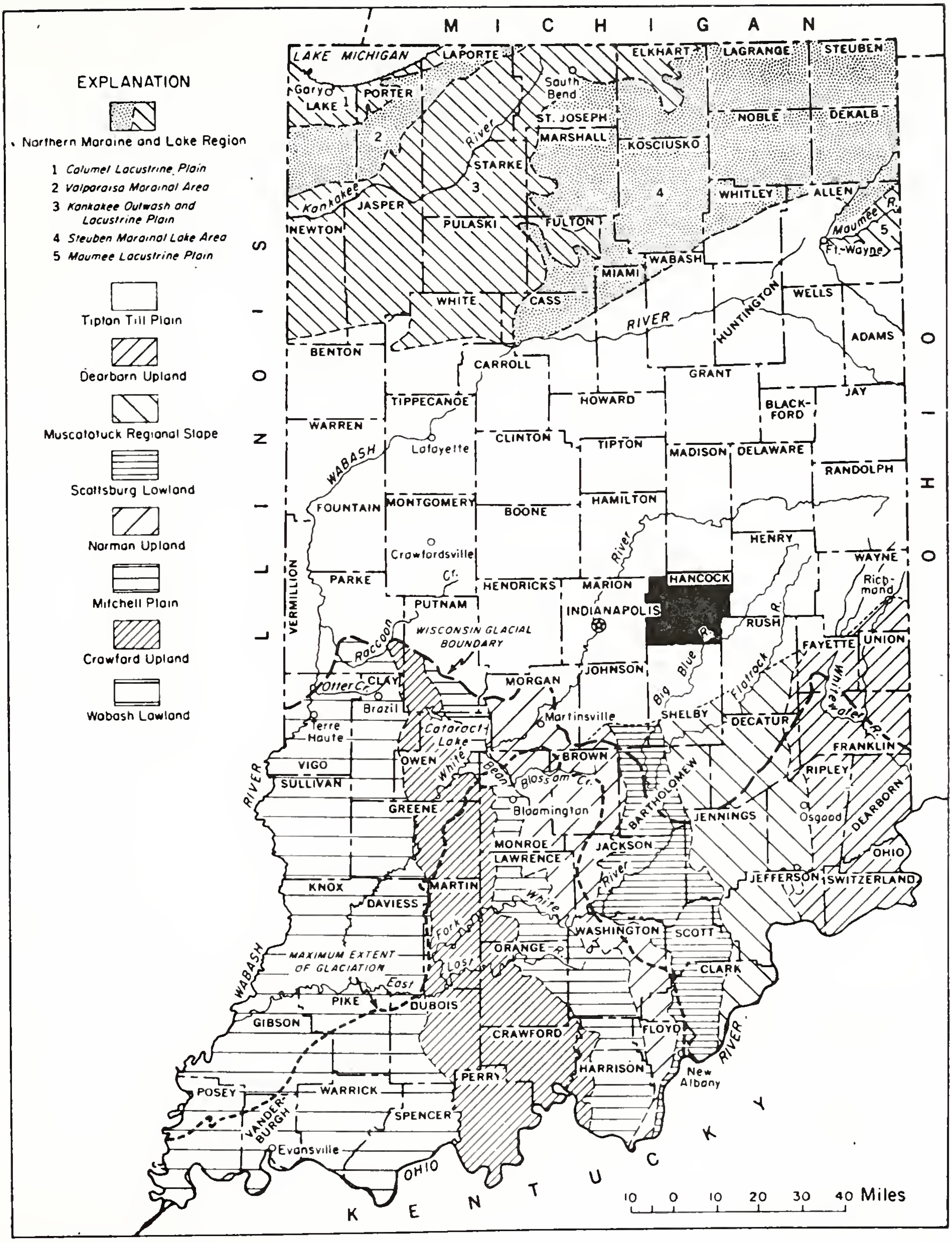


FIGURE 5. Map of Indiana Showing Physiographic Units, Glacial Boundaries and Location of Hancock County. Modified from Indiana Geol. Survey Rept. Prog. 7, Fig. 1.

Topography

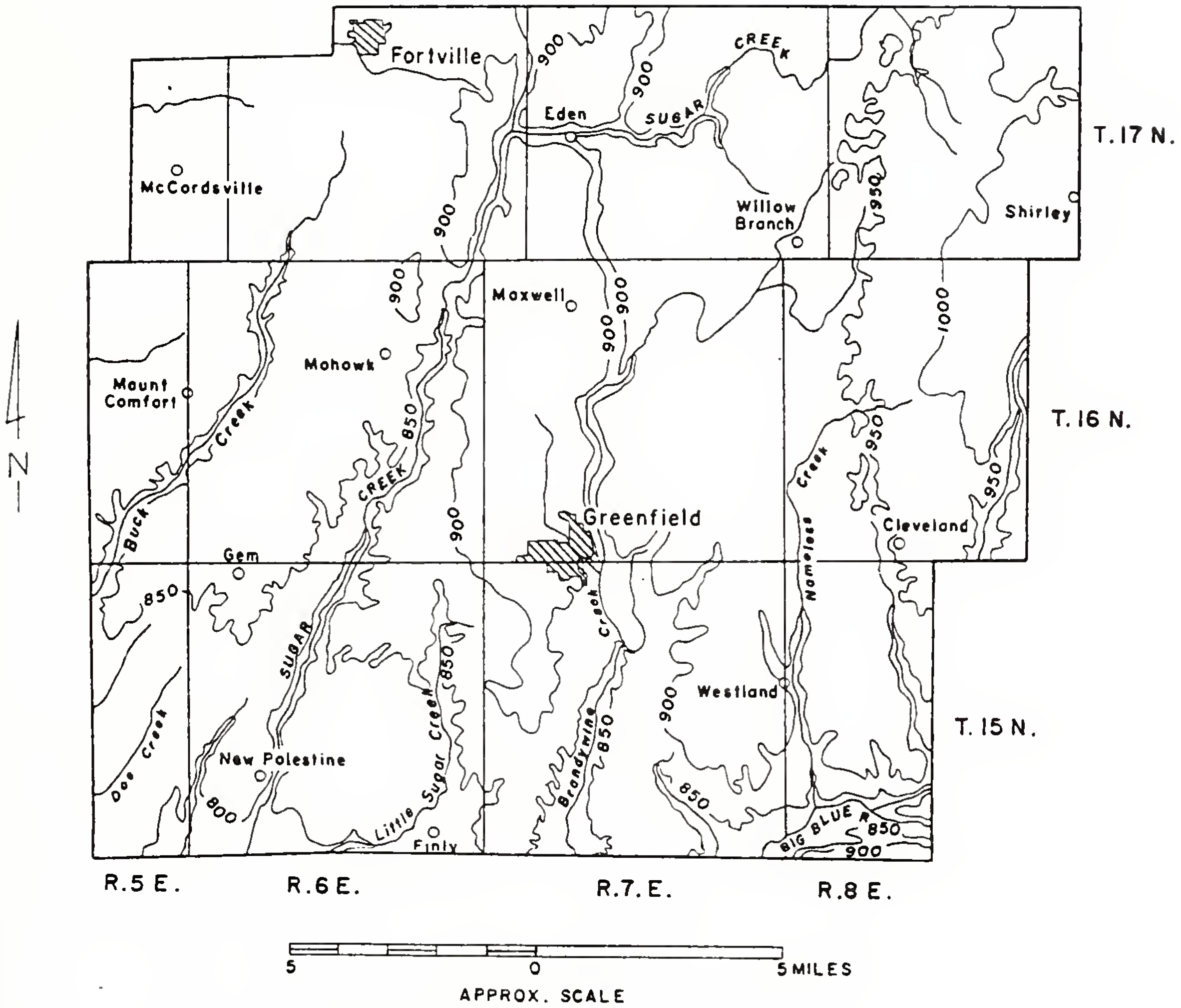
The topography of Hancock County (see Figure 6) was generally flat to gently undulating, broken occasionally by stream valleys and hummocky tracts of ridge moraine. Areas of kettle - kame topography were found in association with the ridge moraine and shallow, former glacial meltwater channels were found on flat areas of ground moraine between and intersecting with present stream valleys.

The greatest relief in the county, about 80 feet, occurs in the southeast corner of the county near the Blue River and its main tributaries, Sixmile and Nameless Creeks (4). The highest elevation, 1035 feet above mean sea level, occurs just north of the town of Shirley in the northeast part of the county. The lowest elevation, 781 feet, is found in the Sugar Creek Valley near the Shelby County line (4).

Bedrock Geology

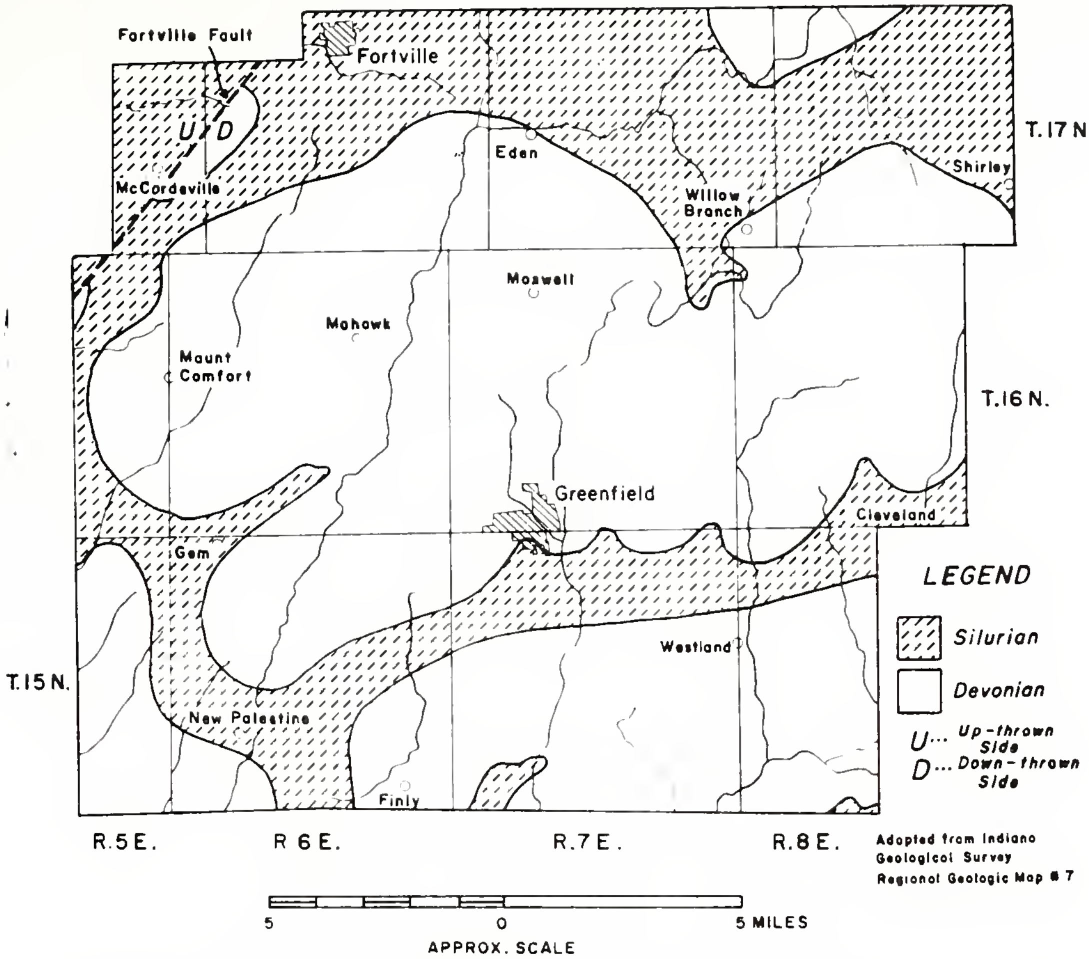
The bedrock formations found beneath the overburden in Hancock County, shown in Figure 7, were of Silurian and Devonian age (4). The rock lithology of both ages was limestone or dolomite, however, strata of Silurian age was more argillaceous. A generallized stratagraphic column for central Hancock County is shown in Table 5.

The bedrock in Hancock County was overlain in most places by 50 to 250 feet of glacial drift (4). The thickness of the drift



CONTOUR INTERVAL, 50 FEET

FIGURE 6. TOPOGRAPHIC MAP OF HANCOCK COUNTY (4)



Adopted from Indiana Geological Survey Regional Geologic Map # 7

FIGURE 7. BEDROCK MAP OF HANCOCK COUNTY (4)

TABLE 5. INFERRED GEOLOGIC COLUMN FOR CENTRAL HANCOCK COUNTY (4)

Geological Units	Dominant Lithology	Range of Depth	Approximate Thickness	Elevation at Top of Unit
Glacial Drift	clay-till-s&g	0-150	150	900 (Surf. Elev.)
Devonian	ls-dolo	150-200	50	725
Silurian	dolo-ls-sh	200-350	150	675
Maquoketa	sh-ls	350-1000	650	500
Trenton	dolo-ls	1000-1150	125	-100
Black River	dolo-ls	1150-1500	350	-225
Chazyan	sh	1500-1525	25	-575
Knox	dolo	1525-3025	1500	-600
Eau Claire	ss-sh-dolo-ls	3025-3625	600	-2100
Mt. Simon	ss	3625-4400	800	-2700
Precambrian	"granite"	4400	XXX	-3500

abbreviations: s&g = sand & gravel; sh = shale; ls = limestone; dolo = dolomite; ss = sandstone.

was primarily a function of the preglacial bedrock topography (see Figure 8) being generally thickest over old bedrock valleys and thinnest over old bedrock highs. There were no known outcrops in Hancock County at the time this report was written (7). A generallized geologic profile along I - 70, shown in Figure 9, illustrates the relationship between the glacial drift and the bedrock formations.

Hancock County lies just west of the apex of a large anticline known as the Cincinnati Arch (see Figure 10). The beds dip about 15 feet per mile to the southwest. The Fortville fault, a high angle fault with a displacement of about 50 feet, cuts across the northwest corner of the county.

Glacial Geology

Most of the overburden in Hancock County was deposited during at least three distinct glacial episodes. Material deposited by the earlier Kansan and Illinoian glacial periods was overlain by the more recent overburden deposited by the Wisconsinan glacial ice sheet which receded approximately 10 to 12 thousand years ago. Most of the glacial drift exposed at the surface was of Wisconsinan age, however, it is possible that some Illinoian (Butterville Formation) or Kansan (Cloverdale Formation) drift was exposed where relatively deep erosional cuts were made in the overburden by Six Mile, Nameless, Brandywine, and Sugar Creeks (9). The Wisconsinan drift, or Trafalgar Formation, was divided into the upper Cartersburg and lower Center Grove Till Members by

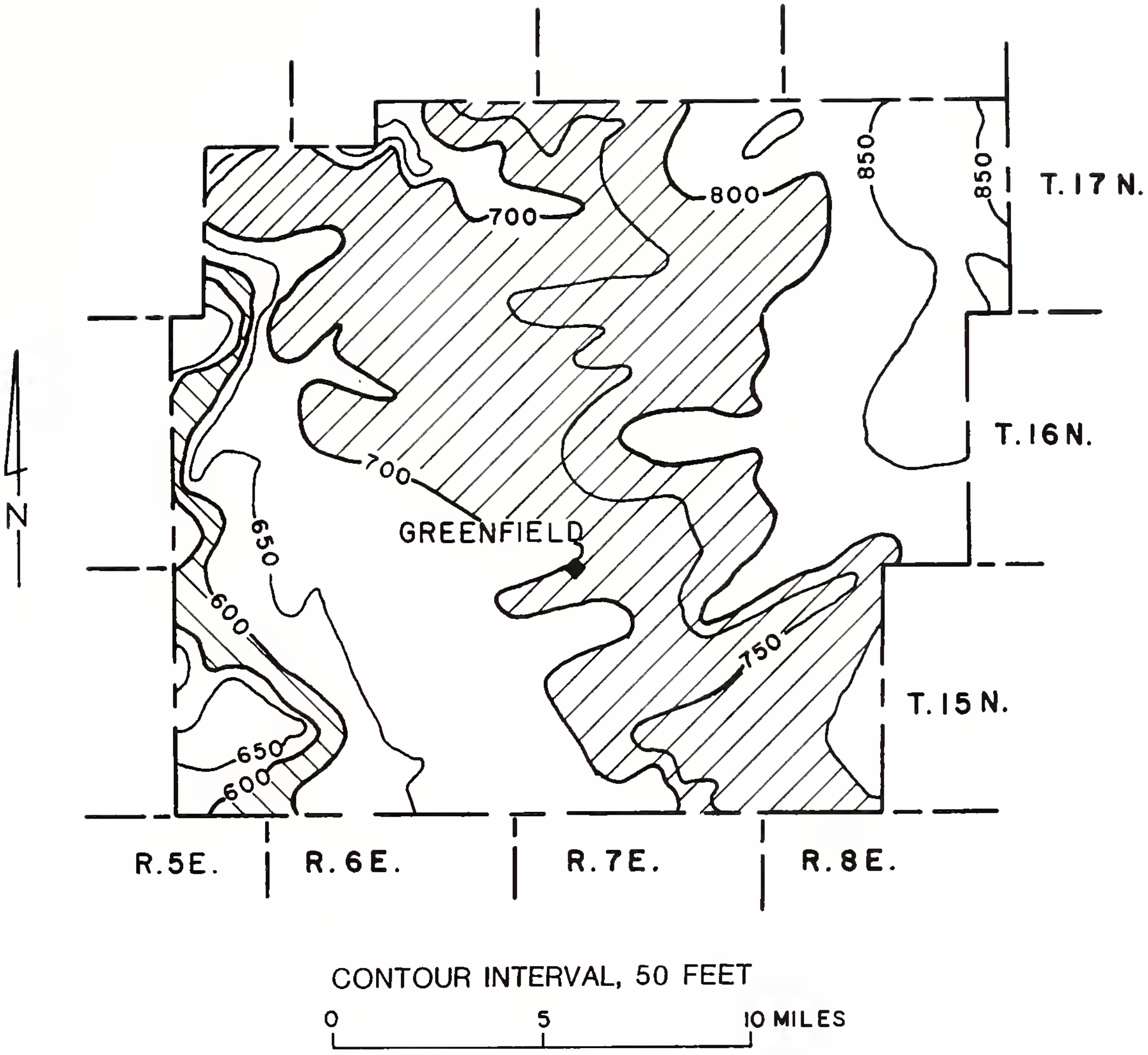


FIGURE 8 BEDROCK TOPOGRAPHY OF HANCOCK COUNTY (22)

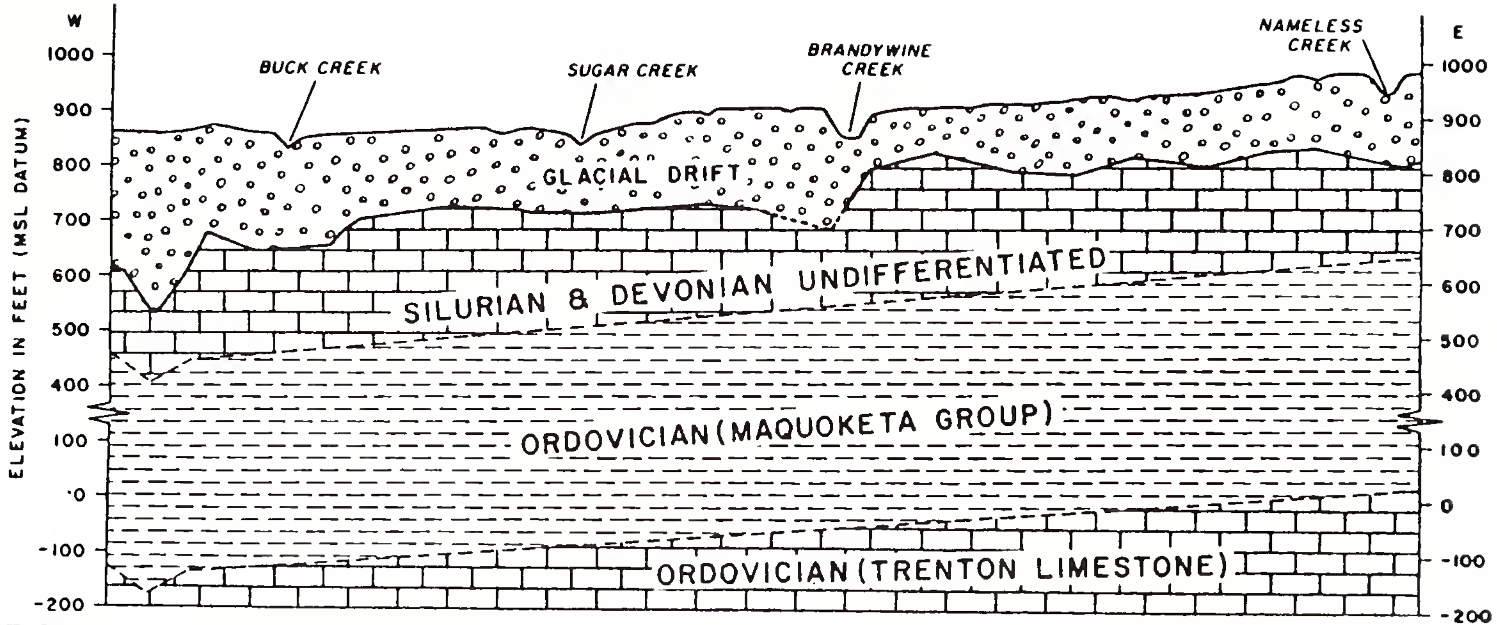

W
E
NAMELESS CREEK
BUCK CREEK
SUGAR CREEK
BRANDYWINE CREEK
GLACIAL DRIFT
SILURIAN & DEVONIAN UNDIFFERENTIATED
ORDOVICIAN (MAQUOKETA GROUP)
ORDOVICIAN (TRENTON LIMESTONE)
ELEVATION IN FEET (MSL DATUM)
1000
900
800
700
600
500
400
100
0
-100
-200

FIGURE 9. GENERALIZED GEOLOGIC CROSS SECTION OF HANCOCK COUNTY APPROXIMATELY ALONG I-70 (4).

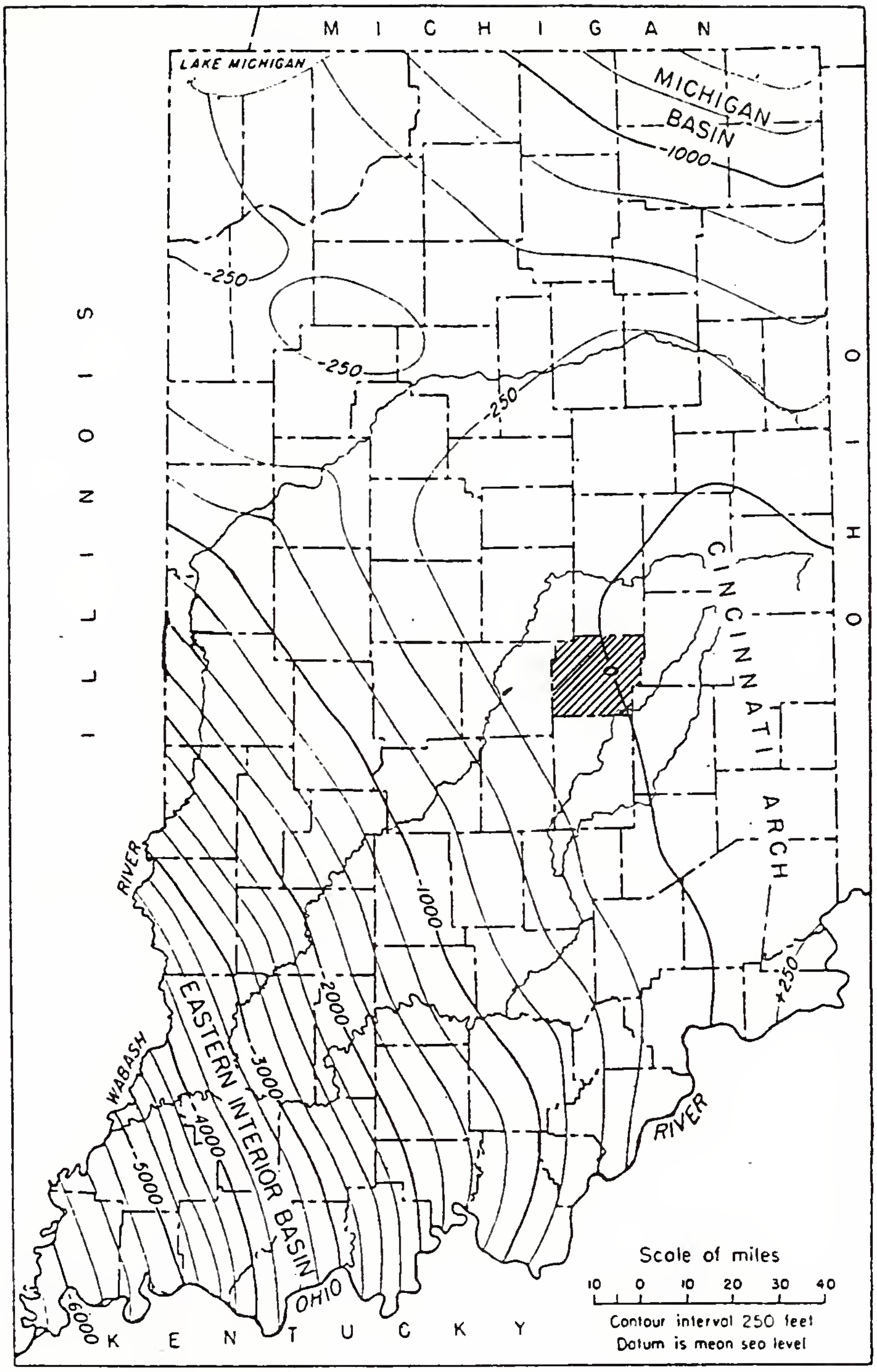


FIGURE 10 REGIONAL BEDROCK STRUCTURE OF HANCOCK COUNTY, INDIANA (21)

a thin layer of fossiliferous silt known as the Vertigo alphestris oughtoni bed (9). Figure 11 shows the relationship between the various Pleistocene deposits in Hancock County.

Drift thickness varied from less than 100 feet to greater than 300 feet (see Figure 12) (10). Drift over 300 feet thick was found associated with a deep, preglacial bedrock valley found along the western county line. The drift was less than 100 feet thick in the southeast and northeast parts of the county. Drift thickness varied between 100 and 200 feet throughout most of the rest of the county.

Ridge moraine was found in the eastern half of the county whereas ground moraine predominated throughout the western half of the county.The ridge moraine mapped by the author correlated reasonably well with that mapped by Malott (11) and Leverett (12). However, the ridge moraine mapped by the author and shown on the engineering soils map which accompanies this report was found primarily in patches and isolated areas which were occasionally connected by narrow bands, except along the eastern county line where it was more contiguous. The ridge moraine mapped by Malott consisted of two tracts, one which skirted the eastern county line and another which stretched in an arc from the northeast corner to the southwest corner of the county. Infiltration basins and ice block depressions, some with associated peat and muck, were numerous in the generally more permeable, coarser textured ridge moraine. Large (> 10 acres) areas of highly organic topsoils located in swales in the ground moraine

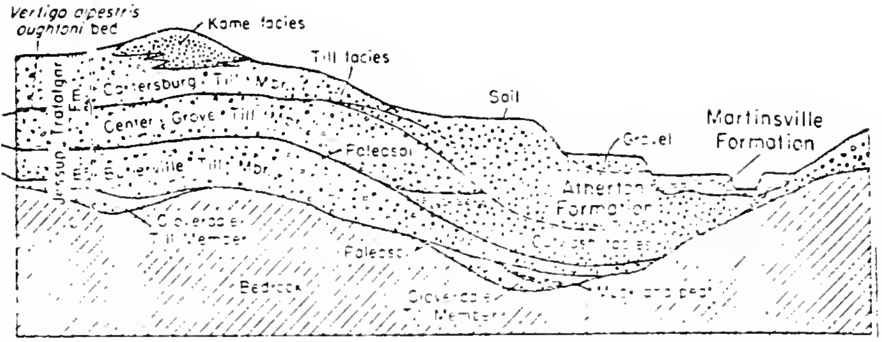


FIGURE 11. FACIES OF THE TIPTON TILL PLAIN GLACIAL DEPOSITS (9)

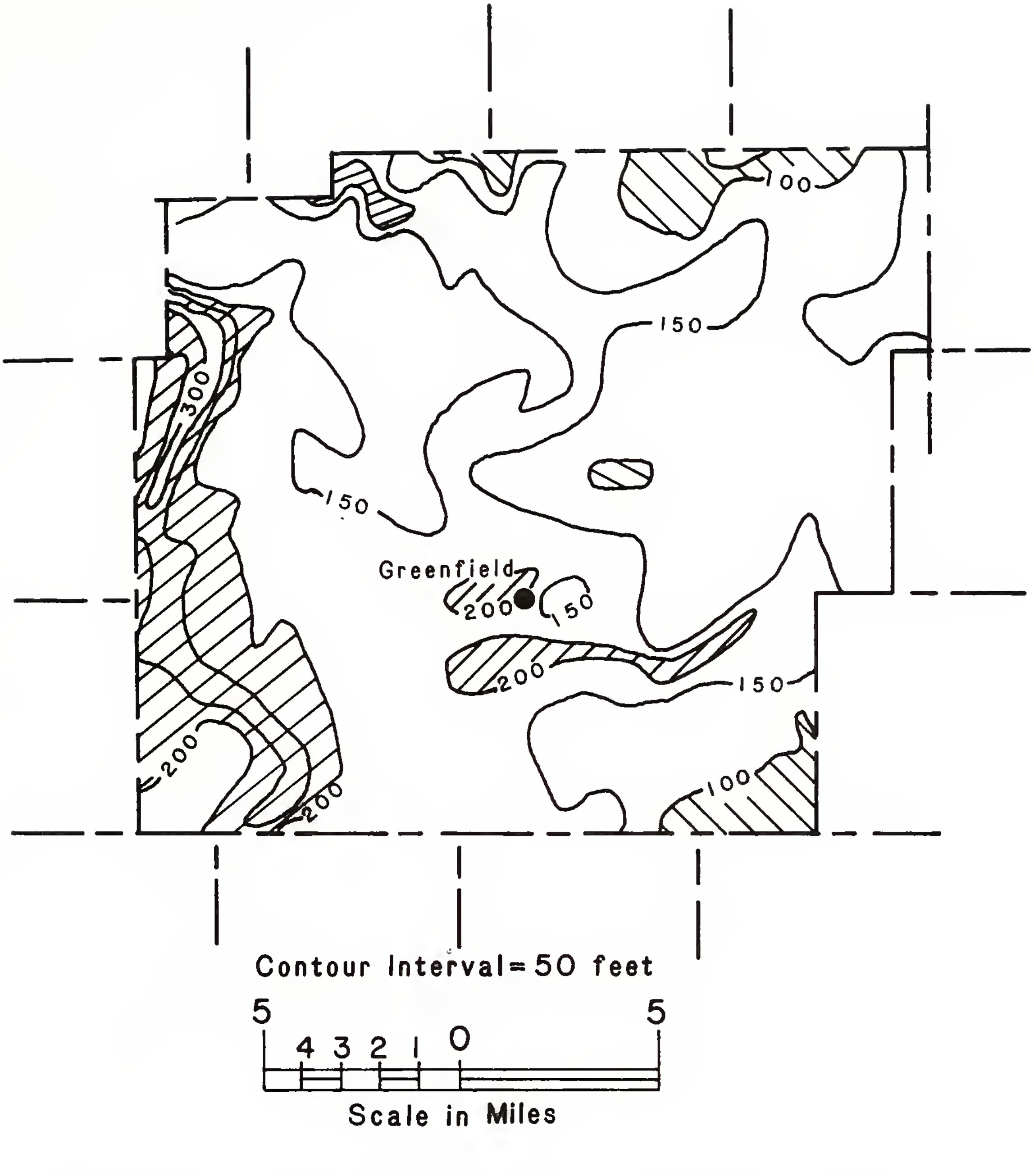


FIGURE 12. DRIFT THICKNESS OF HANCOCK COUNTY (10)

were more numerous than those found in the ridge moraine.

Outwash deposits in Hancock County consisted primarily of glacial sluiceway systems which were found predominantly in the central and western parts of the county. Some of the sluiceways were up to 3/4 of a mile wide, such as those associated with the present stream course of Brandywine Creek. Another major sluiceway system was associated with the upper reaches of Buck Creek in the northwest part of the county. Relatively long, narrow deposits of peat or muck were found associated with the Brandywine sluiceway system, the largest of which was located in sections 4 and 9, T16N, R7E. A broad band of outwash terrace was found adjacent to the Blue River in the southeast corner of the county. These outwash terrace deposits were part of extensive glacial valley - fill sands and gravels deposited by Wisconsinan glacial meltwaters along the present coarse of the Blue River (4).

Kames and eskers were found throughout both the ridge and ground moraine. Clusters of kames were found in sections 16 and 28 and 29, T17N, R8E in the ridge moraine. Three large (ie., more than 40 acres) kames were located in sections 17 and 18, T16N, R7E.

ENGINEERING SOIL AREAS

Glacial Deposits

Glacial deposits in Hancock County, Indiana include ridge

and ground moraine. The ridge moraine is found primarily in the eastern half of the county while ground moraine predominated in the western half. Kames and eskers are considered glacial deposits but were herein discussed as glacio - fluvial deposits.

Ridge Moraine

Ridge moraine in Hancock County was generally well - defined and was characterized by hummocky topography with local relief which varied from about 10 to 30 feet. Kames within the ridge moraine stood up to approximately 30 feet or more above the surrounding land surface, while the bottom of small kettle ice block, or infiltration basins were found to lie 10 to 15 feet beneath the surrounding land surface.

Swells in the ridge moraine typically had a silt loam or sandy loam surface soil which extended to a depth of approximately 8 to 15 inches (2). The surface soil was underlain to a depth of about 26 to 44 inches by a clay loam with pebbles and some gravel. The basic underlying parent material of the ridge moraine was a silty loam-till with pebbles and some gravel. Boulders may be expected within the ridge moraine, sometimes appearing in clusters or "boulder trains". No such trains were documented in the literature reviewed nor were any suggested by the available borehole data. Areas where boulders appeared to be common were found associated with areas of past or present fluvial activity during field investigations and were located on the map which accompanies this report by a symbol listed under "Mis-

cellaneous" in the map legend. Swales in the ridge moraine were characterized by a silt loam or clayey-silt loam surface soil which extended to a depth of about 6 to 14 inches. A sandy loam was found beneath the surface soil to a depth of approximately 12 to 32 inches, which in turn was underlain by a silt loam with pebbles and some gravel which reached a depth of about 36 to 72 inches (2). A silty loam-till with pebbles and some gravel, the basic parent material of the ridge moraine, was found beneath the silt loam.

Generalized profiles developed from agricultural and roadway soil survey data are shown for both swells and swales in ridge moraine on the left-hand side of the engineering soil map.

Roadway soil survey data obtained from boreholes along S.R. 9 (13) in the ridge moraine about 1.5 miles north of Greenfield revealed the following generalized texture related variations with depth for that section of ridge moraine:

Table 6. Ridge Moraine Borehole Texture Data, (boreholes 31,32,33,34) (13).

		percent					
Depth(feet)	AASHTO	Sand	Silt	Clay	LL	PL	PI
0.0 - 1.5	A - 4(0)	51	31	18	22	17	5
1.5 - 3.0	A - 6(10)	29	32	39	35	18	17
3.0 - 4.5	A - 4(0)	45	33	22	21	15	6
4.5 - 6.0	A - 4(2)	36	35	29	22	15	7

The borehole data indicated the generally sandy texture which was typical of the ridge moraine soils. Note the increase in plasticity between about 1.5 to 3.0 feet, a common phenomenon in the B - horizon where clay minerals and clay - sized particles tend to accumulate. For more detailed information for the numbered boreholes shown on the engineering soils map, refer to Appendix A in the back of this report.

Moisture content, specific gravity, and pH data obtained from analysis of soil samples taken from boreholes 31, 32, 33, and 34 and adjacent holes in ridge moraine are shown in Table 7. Figure 13 gives the grain size distribution, plasticity indecies, maximum wet and dry densities, and optimum water content of a soil sample taken from the B - horizon in ridge moraine along S.R. 9 in Hancock County. The graph shows the relationship between dry density and CBR for the particular soil sample used.

Ground Moraine

Ground moraine in Hancock County was characterized by a gently undulating land surface wherein the relief generally did not exceed about 10 to 15 feet. The broad, extensinve, nearly flat areas of ground moraine were broken occasionally by stream dissection, old glacial sluiceways, ice block depressions, sandy knolls or kames, and small tracts of ridge moraine, particularly in the north - central part of the county.

Table 7. Ridge Moraine Soil Property Data (13)

Map Borehole Number	Survey Boring Number	Station	Offset Line "0"	Sample Number	Depth (ft.)	Natural Moisture Content (%)	Specific Gravity	pH
31	1	162+00	21' Lt.	SS-1	1.0-2.5		2.69	7.2
32	2	165+00	23' Rt.	Bag	3.5-4.5		2.75	6.9
32	2	165+00	23' Rt.	SS-3	6.0-7.5	13.5		
32	2	165+00	23' Rt.	SS-5	11.0-12.5	31.0		
33	3	167+87	48' Rt.	SS-2	3.5-5.0		2.76	7.2
33	3	167+87	48' Rt.	SS-3	6.0-7.5	21.3		
	4	172+00	28' Lt.	SS-3	6.0-7.5	23.6		
	4	172+00	28' Lt.	SS-7	21.0-22.5	7.6		
34	5	175+00	27' Rt.	Bag	1.5-3.0		2.82	8.2
34	5	175+00	27' Rt.	JS-11	5.0-5.5	24.8		
	6	163+50	24' Lt.	JS-8	2.4-2.9	18.4		
	7	169+37	33' Lt.	SS-2	3.5-5.0	19.8		
	TP-8	163+50	24' Rt.	Bag 1 & 2	1.5-2.5		2.75	7.3

Figure 13. Ridge Moraine Soil Property Data for a Sample From the B-Horizon (13)

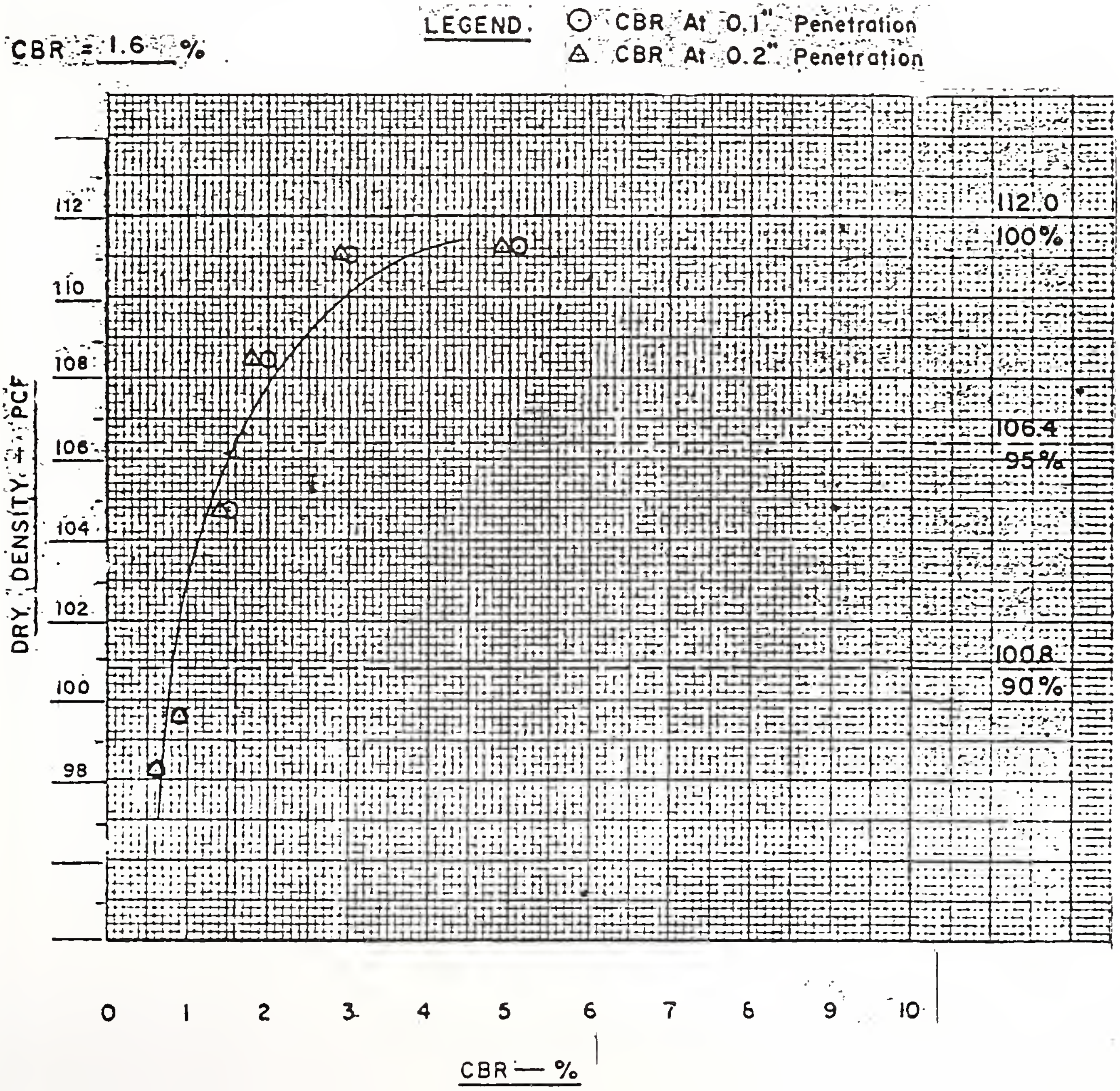
MAX. WET DENSITY: 130.1 pcf
MAX. DRY DENSITY: 112.0 pcf
OPTIMUM MOISTURE: 16.0 %

CLASSIFICATION: CLAY - A-6 (12)
4.8 % GRAVEL
23.4 % SAND
37.0 % SILT
34.8 % CLAY

SIEVE SIZE	% PASSING
10	95.2
40	89.8
200	71.8

LL = 36.6
PL = 17.8
PI = 18.8

CBR = 1.6 %



Swells in the ground moraine were characterized by a silt loam surface soil which was underlain to a depth of about 12 - 34 inches by a sandy loam (2). A sandy-clay loam extended from an average depth of 24 inches to approxmately 54 inches. A clay loam till with some pebbles and gravel, the basic parent material of the ground moraine, was found beneath the sandy - clay loam.

Swales in the ground moraine typically had a silt loam or silty - clay loam surface soil which was underlain at a depth of 8 to 24 inches by a sandy - clay loam. The sandy - clay loam was underlain at a depth of about 60 inches by a clay loam with some pebbles and gravel, the basic parent material of the ground moraine. Generalized profiles developed from agricultural and roadway soil survey data and field sampling are shown on the left - hand side of the engineering soils map which accompanies this report for both high and low topographic positions in the ground moraine. Profiles for all the other engineering soil areas subsequently described are also shown on the map.

The textural data shown in Table 8 were arrived at by averaging the values of several soil samples taken at various depths obtained from roadway soil survey borings made in ground moraine throughout the county.

Table 8. Ground Moraine Borehole Texture Data,(boreholes 2,3,4,5, 6,14,15,16,20,23, and 38) (14),(15).

Depth(feet)	AASHTO	Sand	Silt	Clay	LL	PL	PI
		percent					
0.0 - 1.5	A - 6	37	37	26	32	19	13
1.5 - 3.0	A - 7	21	40	39	51	23	28
3.0 - 4.5	A - 5	38	34	28	25	18	7
4.5 - 6.0	A - 6	41	28	31	32	17	15
6.0 - 8.5	A - 3	57	21	22	21	12	9
8.5 - 10.0	A - 6	31	37	32	28	16	12

The borehole data indicated that the texture of ground moraine soils was generally less coarse than ridge moraine soils (see Table 6). However, inspection of the AASHTO classification shows the ground moraine soil ranged from A - 3 to A - 7, indicative of the textural variations found within the heterogeneous deposits of ground moraine. Again note the inrease in plasticity in the B-horizon at a depth of about 1.5 - 3.0 feet.

The engineering soil data shown in Table 9 and Figures 14 and 15 were obtained by analysis of soil samples taken from borehole #36 in the ground moraine. It should be understood, as previously mentioned, that the texture of soils developed in ground moraine can vary greatly and the engineering properties vary accordingly.The engineering soil properties shown, although site - specific, may provide the engineer with some idea of the kinds of values which might be expected for the tests indicated for samples taken from ground moraine in Hancock County.

Table 9. Ground Moraine Soil Property Data (15).

CBR TEST RESULTS

Station: 61+60 Boring #2
Offset: 45' Rt
Depth: 0.5-2.0
Description: Dark Gray Clay Loam with trace of organic matter A-6(9)
Max. Std. Proctor Dry Density 107.4
Optimum Moisture: 17.8

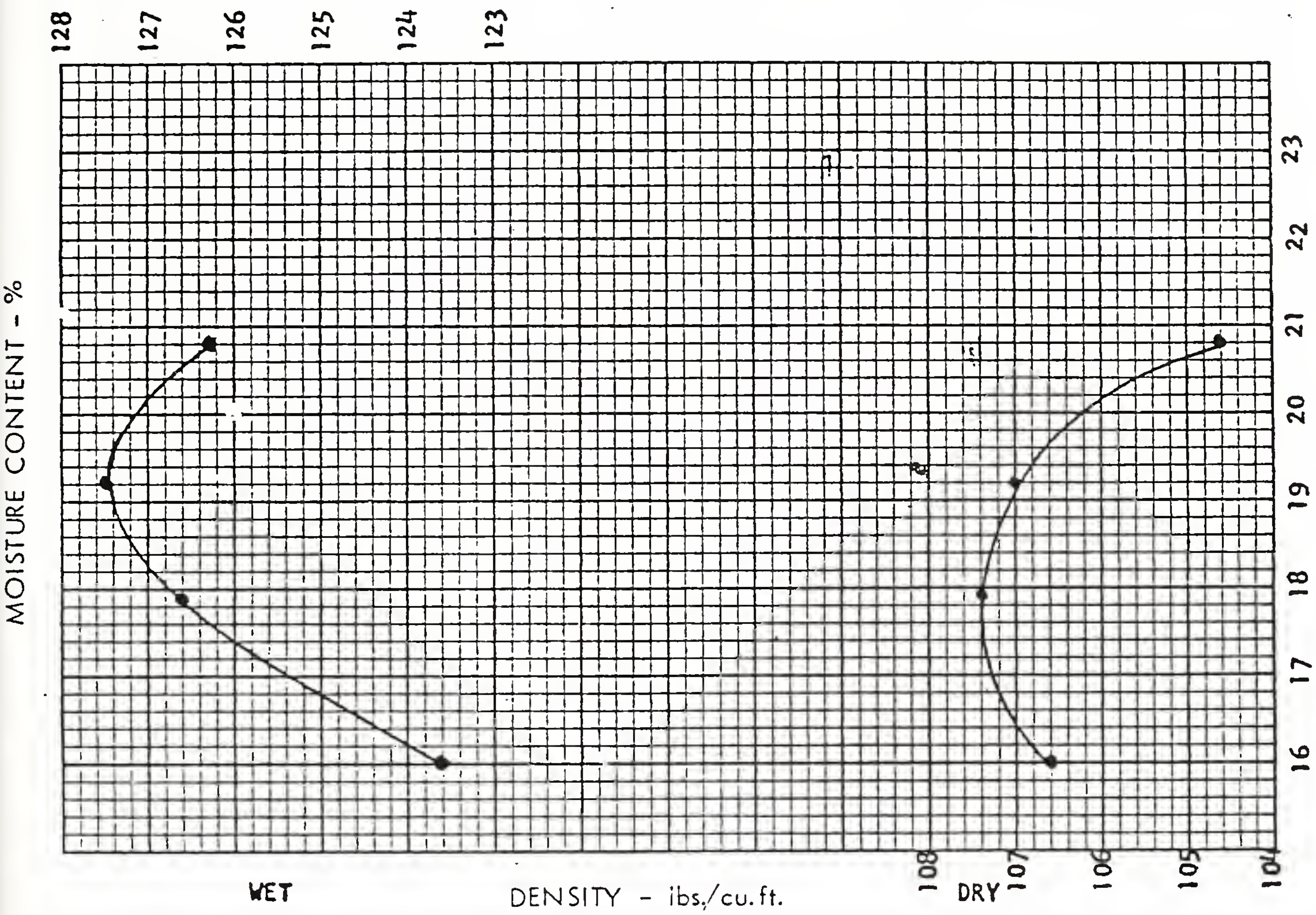
Specimen	Average Water Content, % As Molded	Average Water Content, % After Soaking	Initial Dry Density, pcf	% Max. Dry Dens. pcf	Swell, %	CBR, %
1	18.1	22.9	94.6	87.4	0.40	0.87
2	18.2	23.3	96.7	89.4	0.40	1.21
3	18.5	21.6	100.5	92.9	0.30	3.67
4	18.4	21.4	101.6	94.0	0.30	3.32
5	18.4	18.8	106.8	99.4	0.08	6.30
6	18.3	19.2	107.6	100.2	0.20	6.71
Average	18.3	21.2				

Dry Density, pcf	% Max. Dry Density	Selected CBR, %
107.4	100	6.6
102.0	95	4.0
96.7	90	1.6

Somple Description **Dark gray clay loam with trace of organic matter A-6(9)**

Test Type: **Standard** Proctor; Mold Size **4** in.

Hommer wt. **5.5** lbs.; Drop **12** in., **3** layers, **25** blows/layer.



Moximum Dry Density **107.4** lbs./cu.ft.   Optimum Moisture **17.8** %

Remarks **Max. Wet Density 127.5 pcf**

Figure 14. Ground Moraine Soil Property Data (15).

Figure 15. Ground Moraine Soil Property Data (15).

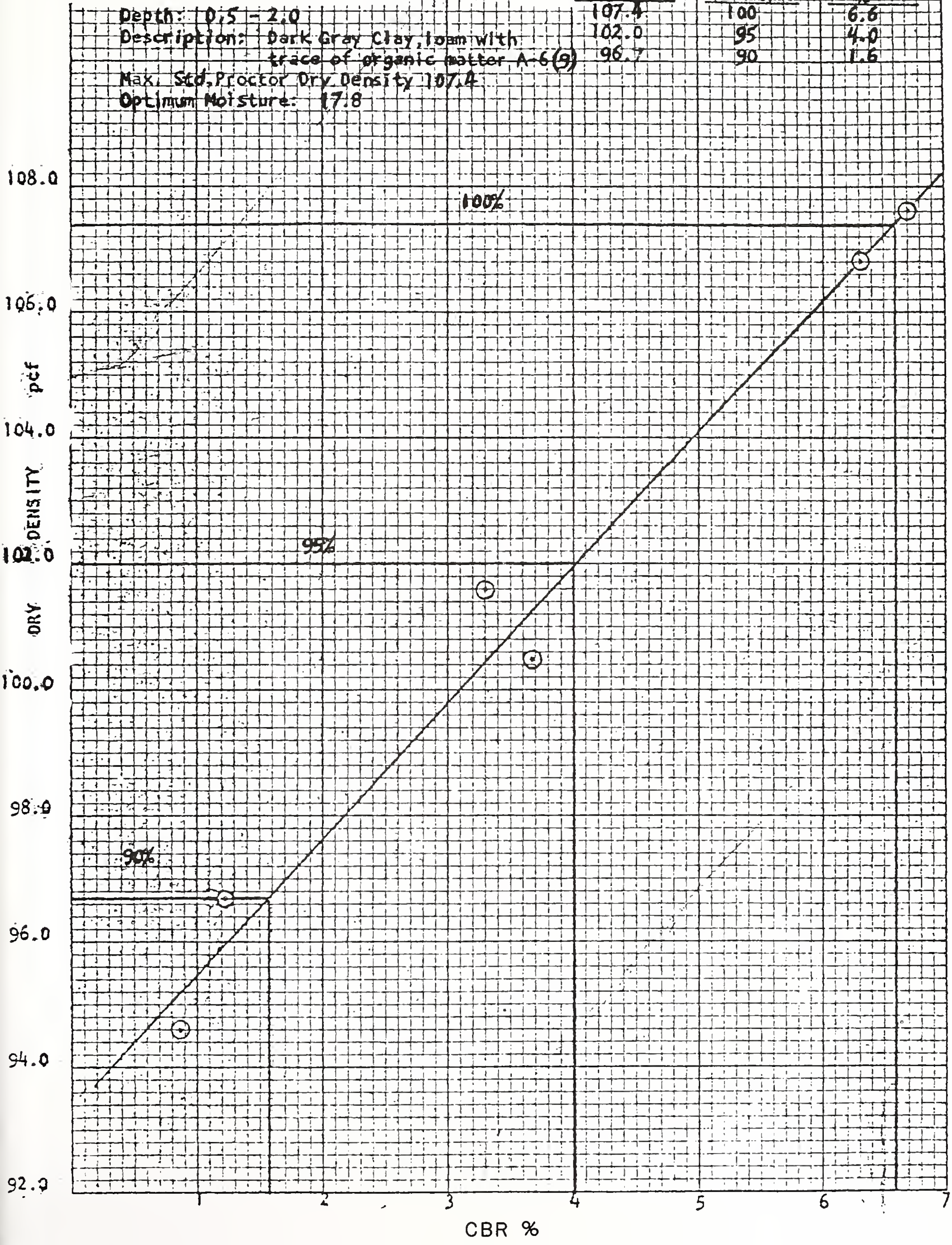
Dry Density pcf	% Max. Dry Density	Selected CBR %
107.4	100	6.6
102.0	95	4.0
96.7	90	1.6

Depth: 0.5 - 2.0

Description: Dark Gray Clay, loam with trace of organic matter A-6(9)

Max. Std. Proctor Dry Density 107.4

Optimum Moisture: 17.8



Some Roadway borehole data for Wisconsinan age (Trafalgar Formation) till revealed a distinct increase in N-values between a depth of about 10 to 15 feet (19), presumably associated with the fossiliferous silt bed (9). An example of this phenomenon is given in Table 10 which lists N-values for a borehole made in Wisconsinan drift in Hancock County (19).

Table 10. Penetration Data for Ground Moraine (19)

Sample #	Soil Classification	N-value	depth(ft)
1	Brown clayey silt with trace gravel	15	3.5-5.0
2	Gray sand with gravel	55	8.5-10
3	Gray clayey silt with trace gravel	29	13.5-15
4	Gray clayey silt with trace gravel	28	18.5-20
5	Gray sand and gravel with silt	30	23.5-25
6	Gray sand and gravel with silt	33	28.5-30
7	Gray clayey silt with trace sand and gravel	41	33.5-35
8	(same as sample 7)	43	38.5-40
9	(same as sample 7)	42	43.5-45
10	(same as sample 7)	40	48.5-50

Table 11 gives the areal distribution of the pedalogical soil series which developed on ground and ridge moraine in Hancock County as a percent of total county area.

Table 11. Relative Ditribution of Soil Series Developed on Ground and Ridge Moraine (2).

Soil Series	Percent of County Area
Brookston	33.0
Crosby	40.1
Miami	14.0

	87.1 total

Ridge and ground moraine comprised nearly 90 percent of the county surface area and were by far the predominant engineering soil areas in Hancock County. There were small inclusions of soil series other than the three primary ones shown in the ridge and ground moraine. The engineering properties of these and all other pedalogical soil series subsequently mentioned with regard to the engineering soil areas are listed in Appendix B of this report. Appendicies C through F give soil characteristics useful for planning various engineering facilities.

GLACIO - FLUVIAL DEPOSITS

Glacio - fluvial deposits, as herein defined, included all land form - parent material associations deposited by waters derived from the continental ice sheets. Outwash terraces, glacial sluiceways, thin outwash - covered drift, and kames and eskers were considered the glacio - fluvial deposits found in Hancock County, Indiana.

Outwash Terraces

Outwash terraces were found in the southeast corner of Hancock County adjacent to the Blue River and along two of its main tributaries, Six Mile and Brandywine Creeks. Outwash terrace deposits differred from recent river terraces in that they were composed primarily of sediment (mostly sand and gravel) derived from the Wisconsinan ice sheet and were deposited by meltwaters. Recent river terraces were composed of recently eroded sediments and outwash sands and gravels which had been reworked (ie., moved, abraided and further rounded) by post - glacial fluvial processes. The outwash terraces along the Blue River were generally broader and more extensive than those found along Six Mile and Brandywine Creeks and their contemporary counterparts, the recent river terraces.

Both recent river and outwash terrace deposits were formed by similar processes and were composed of comparable parent materials. Subsequently, similar soils developed on them. Outwash

terraces, in general, varied more greatly in texture laterally, (presumably because they were broader and were deposited by water which varied more in velocity and sediment size carrying capacity), and were generally more coarse and more poorly sorted than the recent river terraces. Outwash terrace deposits were commonly overlain by approximately 8 to 15 inches of a silt loam or sandy silt loam surface soil which was underlain to a depth of about 20 to 34 inches by a sandy - silt loam soil (2). Between about 26 to 48 inches was found a gravelly - clay loam which was underlain by stratified sands and gravel with some cobbles and boulders, the basic parent material of outwash terraces.

The primary pedalogical soil series which developed on the outwash terraces was the Ockley soil. Rensselaer and Westland soils were also found on the outwash terraces, however, they were developed in the low - lying sluiceway channels, current scars, and infiltration basins (2). Numerous operating and abandoned gravel pits were located on the outwash terraces. The Ockley soil series occupies about 2.5 percent of the surface area of Hancock County (2).

Glacial Sluiceways

Glacial sluiceways were most common in the ground moraine, however, they were also found in the ridge moraine and as braided stream - like channels on the outwash terraces. In some cases, streams occupied parts or all of old sluiceway systems or cut

across them, reworking the old sluiceway sediments and depositing new alluvial material. Present drainage appeared to be in opposite directions from a high point within some of the sluiceways and man - made drainage trenches were not uncommon to help facilitate the movement of water. Surface soils near the upper reaches of many small streams near the drainage divides were virtually analogous to undisturbed glacial sluiceway sediments, regardless of whether or not these present drainageways ever served as meltwater channels.

Sluiceways Over Outwash Terraces

Glacial sluiceways were found on the outwash terraces along the Blue River in the southeast corner of Hancock County. These sluiceways were characterized by a loam or silty - clay loam surface soil which was underlain at a depth of about 12 to 15 inches by a clay loam with pebbles which extended to a depth of about 36 to 48 inches (2). The clay loam graded into the stratified sand and gravel parent material of the outwash terraces through a one to two feet thick transitional zone. Several operating gravel pits were located in the sluiceways on the agricultural map sheets (2). The Westland, Rensselaer, and Whitaker pedalogical soil series were developed on the sluiceways over outwash terraces.

Sluiceways Within Ground and Ridge Moraine

Glacial sluiceways within ground and ridge moraine were characterized by a silty - clay loam surface soil which was underlain at a depth of about 12 inches by a clay loam with pebbles that extended to a depth of about 36 to 52 inches (2). The clay loam was underlain by a stratified sandy - silt loam with some gravel. The stratified sluiceway sediments, which may contain up to 10 percent gravel (2), were generally underlain at a depth of approximately 10 to 12 feet by a sandy loam or loamy till soil with some gravel, the basic parent materials of ridge and ground moraine, respectively.

Glacial sluiceways were not used extensively as a source of sand and gravel (2) with the exception of the sluiceway system associated with the present course of Brandywine Creek. Several ponds were found on the 1941 aerial photography where gravel pits were operating or were abandoned. Numerous additional gravel pits were located on the agricultural map sheets along the sluiceway system associated with Brandywine Creek. Roadway soil survey borehole texture data for Sluiceways are shown in Table 12.

Table 12. Sluiceways Textural Data (boreholes 11,25, and 30)(14),(16)

Depth(feet)	AASHTO	percent Sand	Silt	Clay	LL	PL	PI
1.0 - 2.5	A - 7 - 6	22	50	28	42	22	20
2.5 - 4.0	A - 7 - 2	26	40	34	41	19	22
4.0 - 5.5	A - 6	52	29	19	28	14	14
5.5 - 7.0	A - 5	45	37	18	25	15	10
7.0 - 8.5	A - 4	62	27	11	19	17	2

The borehole data indicated the general increase in sand content with depth to 8.5 feet. The sluiceway sediments within the ground and ridge moraine areas may extend to a depth of 20 feet or more. Note also that the surface soils were of moderate plasticity. Table 13 shows the relative distribution of the pedalogical soil series which were developed on sluiceways in Hancock County, Indiana.

Table 13. Distribution of Soil Series Developed on Glacial Sluiceways (2).

Soil Series	Percent of County Area
Rensselaer	1.5
Westland	0.5
Whitaker	0.3

	2.3 total.

Westland soils not associated with sluiceways were found on recent river and outwash terraces, however, these areas comprised a small amount of the total 2.3 percent of the county covered by the Rensselaer, Westland, and Whitaker soil series, the soils which developed on the glacial sluiceways.

Thin Outwash Over Drift

Numerous areas where water had deposited a thin (less than 5 feet) layer of outwash or alluvial material were found in Hancock County along present and abandoned watercourses. These areas differ from terrace deposits in that the ground surface is not as smooth, presumably because the blanket of alluvial material was not thick enough to mask the former land surface. Areas of thin outwash over drift also differ from areas of water - reworked till (discussed with alluvial deposits) in that some deposition

took place, whereas areas of till which were reworked by water were more rugged due to lack of significant sediment deposition.

Areas of thin outwash over till were characterized by a loam or sandy loam surface soil which was underlain at a depth of about 10 to 15 inches by a sandy - clay loam with gravel which extended to a depth of about 34 to 54 inches (2). Beneath the sandy - clay loam was found a stratified sandy - silt loam or loam to a depth of 56 to 60 inches. Beneath about 60 inches was found the parent material of the drift, usually a loam or sandy loam - till in the case of ground and ridge moraine, respectively.

The primary pedalogical soil series which developed on areas of thin outwash over drift were the Whitaker and Martinsville. Soils commonly found adjacent to areas of thin outwash over drift are the Westland, Ockley and Rensselaer soil series. These areas comprised less than 1.0 percent of the total county area (2).

Kames and Eskers

Numerous kames and esker - like features were found in Hancock County (see Glacial Geology for locations of prominent features). Kames and eskers, although both composed of glacial sands and gravels, are thought to have formed by somewhat different processes and by definition are of different shapes. Kames are usually knob - like hills several acres in size ranging up to

about 35 feet in height. Eskers are narrow, winding ridges between about 10 to 20 feet in height and from several hundred yards to several miles in length. Although several of the kames in Hancock County were quite large,(ie., > 40 acres), the eskers were subdued features generally not exceeding 0.5 miles in length and 10 feet in height.

A silt loam surface soil was developed on kames and eskers. It was underlain at a depth of about 13 inches by a clay loam which extended to a depth of about 21 inches (2). Gravelly - clay loam underlaid the clay loam to a depth of approximately 50 inches. Beneath about 50 inches was found stratified sand and gravelly sand, the parent material of kames and eskers.

Glacio-fluvial deposits were utilized as sources of sand and gravel for concrete aggregate and roadway subgrade fill. Table 14 shows fragment size distribution and lithology data for a valley-train (outwash terrace or sluiceways) and a kame deposit in Hancock County. These data may be useful in evaluating possible new aggregate sources with respect to specific engineering purposes.

Ockley soils with small inclusions of Miami soils were developed on the kames and eskers found in Hancock County (2). Kames and eskers were not extensively utilized as a source of sand and gravel, although there was evidence on the 1941 aerial photographs of past excavation and some pits were operating at the time of this writing. Kames and eskers comprised less than one percent of the total county area.

Table 14
Grain Size Distribution of Valley-train and Kame Deposits from Schneider and Gray (1966)

Size Analysis of Samples of the Outwash Facies
of the Atherton Formation
NE¼, NW¼, sec. 9, T.15N., R.7E.

Sand/Gravel Ratio	Percentage by Weight		
	¼-½"	½-1"	1-4"
61/39	23	10	67

Size Analyses of Samples of the Kame Facies
of the Trafalgar Formation
SE¼, SW¼, sec. 29, T.17N., R.7E.

Grade Size	Percentage by Weight
Gravel:	
1"to 4"	32
½ ½ to 1"	16
¼ to ½"	7
Sand:	
Below ¼"	45

Lithologic Composition of Gravel Fractions from Samples
of the Kame Facies of the Trafalgar Formation
SE¼, SW¼, sec. 29, T.17N., R.7E.

Rock Type	Percentage by Weight
Limestone	20
Dolomitic limestone	22
Dolomite	32
Other sedimentary rocks	9
Igneous rocks	10
Metamorphic rocks	6

Alluvial Deposits

Flood Plains

The broadest flood plain in Hancock County was that of the Blue River which was nearly a half mile wide at the Shelby County line. Other relatively major flood plains were developed along Six Mile, Nameless, Brandywine, Sugar, and Buck Creeks, however, none of them exceeded one quarter of a mile in width.

Flood plain surface soils were characteristically silt loams or silty - clay loams, possibly with some pebbles (2). The surface soil was underlain at a depth of 12 to 26 inches by a loam or stratified silty - clay loam which was underlain at a depth of approximately 30 to 54 inches by a stratified sandy - silty - clay loam, or a stratified gravelly - sandy loam, the basic parent materials of the flood plain soils.

Several sand pits were operating in flood plain soils in Hancock County, particularly along Brandywine and Sugar Creeks. Several ponds were located within the flood plains, perhaps associated with former sand pit operations. Small swampy areas and deposits of peat or muck were not uncommon in the alluvial plains, particularly adjacent to the valley walls.

The primary soils developed on the flood plains were the Eel, Genesee, Shoals, and Sloan soil series. Table 15 gives the

areal distribution of these soils in Hancock County.

Table 15. Distribution of Flood Plain Soil Series (2).

Soil Series	Percent of County Area
Eel	1.2
Genesee	0.9
Shoals	1.7
Sloan	1.8

	5.6 total.

Recent River Terraces

Recent River terraces include all the terrace deposits that were formed post - glacially (ie., after the meltwaters had abated). Recent river terraces were generally smaller than outwash terraces and were confined to areas immediately adjacent to current watercourses. They were generally topographically lower and were composed of finer, better sorted sands and gravels than the outwash terraces. The sand and gravel was primarily recently eroded, however, substantial quantities were probably redeposited outwash sands and gravels. The better sorting of recent river as compared to outwash sands and gravels may be attributed to a lower water velocity and more consistent flow rates in contemporary rivers as opposed to meltwater channels.

Most of the recent river terraces in Hancock County were found along Six Mile, Nameless, Brandywine, and Sugar Creeks.

Recent river terraces were characterized by a silt loam or sandy - clay loam surface soil which extended to a depth of approximately 14 to 20 inches. The surface soil was underlain to a depth of 46 to 68 inches by a gravelly - clay loam or sandy - clay loam which in turn was underlain by stratified sand and gravel or sandy - silt loam with gravel, the basic parent materials of recent river terrace soils.

The primary pedalogical soil series developed on recent river terraces were the Ockley and Westland. Gravel pits were not uncommon on recent river terraces, particularly along Sugar and Brandywine Creeks. Recent river and outwash terraces covered about 3.0 percent of the county surface area (2).

Water - Reworked Till

Many areas of water - reworked till were found in Hancock County. These areas were characterized by a gently rolling land surface and were identified on the aerial photographs by a bland, blurry surface soil texture appearance with subdued but definite relief. These areas were always associated with past or present watercourses, particularly near drainage divides, within old sluiceway systems, and at past or present stream junctions where water commonly passed through overflow channels. Areas of water reworked till developed anywhere that water intermittently flowed

over the land surface, eroding and redepositing the material present but adding little new sediment.

The water essentially scoured the land surface in a sheetwash effect and tended to remove some of the fines (silt and clay) leaving a sand loam surface soil. An increase in sand content is expected to a depth of about 2.5 to 4.0 feet. Beneath this depth is found a thin zone of clay accumulation which is underlain by the native parent material, the glacial till of the ridge or ground moraine. Field investigations revealed dense accumulations of boulders exposed by action of the water which are not uncommon in areas of water - reworked till. The pedalogical soil series developed on water - reworked till included the Martinsville and Whitaker (2). These soils are also found on thin outwash over till. Table 16 shows the areal distribution of these soils in Hancock County.

Table 16. Distribution of Soil Series Developed on Areas of Thin Outwash Over and Water - Reworked Till (2).

Soil Series	Percent of County Area
Martinsville	0.4
Whitaker	0.3

	0.7 total

Depressional Deposits

Peat and Muck

Numerous deposits of peat and muck were found in Hancock County, particularly in areas of ridge moraine and along old glacial sluiceways systems and present stream channels. Two large areas of peat and muck, up to two miles in length were found along the Brandywine sluiceway system in the north - central part of the county. Numerous small deposits of peat and muck associated with infiltration or kettle - like basins dotted some areas of ridge moraine. Deposits of peat and muck were uncommon in the ground moraine, except along sluiceways and stream channels.

Some areas of peat and muck were overlain by up to 12 inches of an organic-silty-clay surface soil, while peat and muck was found at the surface in other areas. Peat or muck generally extended to a depth of 36 to 72 inches according to agricultural soil survey data (2), however, it was known that peat and muck may extend to tens of feet beneath the surface in such deposits. The peat and muck was generally underlain by a transitional zone of a loamy organic soil or organic-sandy-clay loam. Beneath the transitional zone was found the basic parent material of the surrounding land form, usually glacial till of the ridge moraine, outwash of the sluiceway, or alluvial soils of the flood plains and terraces.

The Palms soil series was developed on deposits of peat and

muck in Hancock County (2). According to agricultural soil survey data, the Palms series covered about 0.2 percent of the county surface area.

Areas of Highly Organic Topsoil

Areas of highly organic topsoil were found in association with swales or shallow ice - block depressions in the ground and ridge moraine. These areas were found mostly in ground moraine and were commonly associated with shallow, poorly developed sluiceway systems. Highly organic topsoil was also found in infiltration basins in ridge moraine and terrace deposits. Not all areas were shown on the map because of small size.

Areas of highly organic topsoil were commonly overlain by 8 to 14 inches of an organic silt or organic silty clay surface soil. The surface soil was underlain to a depth of about 32 to 40 inches by an organic silt loam or an organic silty - clay loam. The organic soils were underlain by a thin (0 to 12 inches) layer of clay loam or silty - clay loam which in turn was underlain by a sandy loam or silt loam glacial till. In some places, a thin (2 to 6 inch) layer of a non-organic clay or silty-clay overlaid the organic surface soil.

The Milford and Kokomo soil series were developed on areas of highly organic topsoil (2). The areal distribution of these soil series in Hancock County is shown in Table 17.

Table 17. Distribution of Soil Series Developed on Areas of Highly Organic Topsoil (2).

Soil Series	Percent of County Area
Kokomo	1.1
Milford	0.5

	1.6 total.

Areas of High Boulder Accumulation

Field investigations revealed several areas of high boulder concentration in Hancock County as previously mentioned with respect to some of the engineering soil areas. The evidence found did not suggest the presence of boulder trains which were deposited by the glaciers as such, but rather that the action of water had left behind the relatively large rock fragments which it could not move. Areas of high boulder concentration were found in areas of water - reworked till and thin outwash over till. An area was also located along the margin of a recent river terrace where it met an old outwash terrace in the southeast corner of the county along the Blue River. Some areas of high boulder concentration were found in ridge and ground moraine, commonly associated with recent alluvial activity. Areas of high boulder concentration were identified by a symbol shown under the `miscellaneous´ heading of the map legend.

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APPENDIX A - Borehole Data *

Job Borehole Number	Map Borehole Number	Station	Offset	Sample Depth (ft.)	Classification		Percent					
					Textural	AASHTO	Sand	Silt	Clay	LL	PL	PI
			Line 'B'		I - Project 70-3(22) 86 P.E.		(14)					
1	1	333+00	42'Lt.	3.5- 4.5	Mottled Br.-Gr. Clay	A-6(12)	29	36	35	40	18	22
5	2	345+00	42'Lt.	0.0- 2.5	Mottled Br.-Gr. Silty Clay loam	A-6(9)	22	53	25	32	19	13
7	3	351+00	42'Lt.	4.0- 6.0	Brown clay loam	A-4(4)	45	30	25	21	12	9
11	4	363+00	42'Lt.	1.5- 3.0	Dark Gray Clay	A-7-6(16)	20	39	41	48	23	25
16	5	375+00	42'Lt.	3.5- 4.5	Brown Clay loam	A-6(7)	34	36	30	29	17	12
19	6	384+00	42'Rt.	4.0- 6.0	Brown Sandy Clay	A-2-4(0)	78	13	9	22	14	8
23	7	396+00	42'Rt	4.5- 6.0	Tan Loam	A-4(6)	36	45	19	26	16	10
27	8	408+00	42'Rt.	2.0- 3.0	Gray Clay loam	A-7-6(13)	42	29	29	45	18	27
30	9	417+00	42'Lt.	1.0- 6.0	Brown Clay loam	A-6(8)	40	32	28	33	16	17
36	10	435+00	42'Lt.	0.0- 1.5	Light Gray Clay loam	A-4(5)	41	37	22	24	14	10
39	11	444+00	42'Rt.	2.0- 3.5	Brown Clay loam	A-6(8)	41	37	22	31	15	16
41	12	450+00	42'Rt.	8.0-10.0	Brown Sandy loam	A-4(1)	63	28	9	17	NP	NP
49	13	472+00	42'Lt.	5.0- 7.5	Brown Sandy loam	A-4(2)	57	30	13	24	21	3
56	14	491+00	42'Rt.	4.0- 6.0	Brown Clay	A-7-6(12)	37	27	36	43	21	22
56	14	491+00	42'Rt.	7.0- 8.5	Gray Clay loam	A-4(5)	42	31	27	24	14	10
58	15	497+00	42'Rt.	9.5-12.0	Mottled Br.-Gr. Clay	A-6(8)	31	37	32	28	16	12
62	16	509+00	42'Rt.	1.5- 3.0	Brown Clay	A-7-6(17)	22	40	38	51	23	28
68	17	527+00	42'Rt.	1.0- 3.0	Dark Gray Clay loam	A-6(11)	39	37	24	39	16	23
77	18	552+00	42'Lt.	3.0- 3.5	Mottled Br.-Gr. Clay	A-7-6(15)	27	36	37	45	21	24
77	18	552+00	42'Lt.	5.5- 6.0	Gr.-Br. Clay loam	A-6(10)	26	45	29	31	17	14
84	19	569+90	42'Rt.	5.0- 5.5	Gr.-Br. Clay loam	A-4(7)	33	41	26	24	15	9
87	20	579+00	42'Lt.	4.0- 5.0	Br. Clay loam	A-4(8)	42	32	26	21	18	3
91	21	591+00	42'Lt.	3.0- 3.5	Br. Sandy Clay	A-6(8)	51	11	38	40	19	21
97	22	609+00	℄	2.0- 9.0	Brown Clay loam	A-4(6)	41	30	29	25	16	9
101	23	620+00	℄	7.0- 8.0	Lt. Br. Sandy Loam	A-2-4(0)	73	11	16	17	10	7
107	24	637+00	42'Lt.	2.0- 4.0	Gr.-Br. Clay	A-6(7)	36	31	33	30	19	11
113	25	649+00	42'Lt.	2.0- 4.0	Mottled Tan-Gray Clay	A-7-6(17)	13	44	43	51	23	28
113	25	649+00	42'Lt.	5.0- 7.0	Brown Sandy loam	A-6(6)	52	29	19	28	14	14
113	25	649+00	42'Lt.	7.0- 8.5	Brown Sandy loam	A-4(1)	62	27	11	19	17	2
113	25	649+00	42'Lt.	8.5-10.0	Gray Silty Clay loam	A-4(8)	12	62	26	19	12	7

APPENDIX A - Continued

					Classification		Percent					
Job Borehole Number	Map Borehole Number	Station	Offset	Sample Depth (ft.)	Textural	AASHTO	Sand	Silt	Clay	LL	PL	PI
					RS Project No. 8030 (1) (18)							
RB- 2	26	217+00	20'Lt.	1.0- 4.0	Clay	A-6(14)	22	47	31	37	17	20
RB-10	27	383+00	12'Rt.	1.0- 2.5	Silty clay	A-6(15	15	53	32	36	18	18
					SOS Project No. 9930 (1) (17)							
B-11	28	71+50	15'Lt.	2.0- 5.0	Brown Silty Clay	A-6(11)	16	54	30	35	20	15
					ST-Project No. 3630 (A) (16)							
RB- 1	29	11+73	9'Lt.	1.0- 2.5	Silty Clay loam	A-7-6(19)	18	54	28	45	23	22
RB- 1	29	11+73	9'Lt.	8.5-10.0	loam	A-4(1)	32	52	16	21	14	7
RB- 2	30	14+22	11'Lt.	1.0- 3.0	clay loam	A-7-6(15)	22	50	28	42	22	20
RB- 2	30	14+22	11'Lt.	6.0- 7.5	loam	A-4(1)	39	46	15	22	15	7
					ST-Project No. 177-7(A)P.E. (13)							
1	31	162+00	21'Lt.	1.0- 2.5	Sandy loam	A-4(0)	51	31	18	22	17	5
2	32	165+00	23'Rt.	3.5- 4.5	Clay loam	A-4(0)	45	33	22	21	15	6
3	33	167+87	48'Rt.	3.5- 5.0	Clay loam	A-4(2)	36	35	29	22	15	7
5	34	175+00	27'Rt.	1.5- 3.0	Clay	A-6(10)	29	32	39	35	18	17
					Project No. S-296 (4) P.E. (15)							
1	35	58+00	15'Lt.	0.5- 2.0	Brown Clay	A-7-6(15)	25	37	38	47	24	23
2	36	61+60	45'Rt.	4.0- 6.0	Gr. Cl. Lm. w/tr. organ.	A-6(9)	30	42	28	34	20	14
8	37	89+00	27'Lt.	2.0- 4.0	Brown Clay	A-6(5)	48	20	32	25	13	12
14	38	114+00	27'Rt.	0.0- 2.0	Br. Sdy. Cl. Lm. w/gravel	A-6(4)	50	22	28	31	20	11

*** Note: Last Number in Parenthesis Following Job Titles Footnotes References.**

Appendix B – Table of Estimated

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Ft	*In*				*Pct*
Brookston: **Br**	0–1 or ponded	0–12	Silty clay loam	CL	A-6 or A-7	0
		12–54	Clay loam	CL or CH	A-6 or A-7	0
		54–60	Loam	CL	A-4 or A-6	0–3
Crosby: **CrA**	1–3	0–12	Silt loam	CL–ML or CL	A-4 or A-6	0
		12–40	Clay loam	CL	A-6 or A-7	0–2
		40–60	Loam	ML, CL–ML, or CL	A-4 or A-6	0–3
Eel: **Ee**	2–4	0–12	Silt loam	CL or CL–ML	A-4 or A-6	0
		12–39	Silt loam, loam, clay loam	CL or ML	A-4 or A-6	0
		39–60	Sand, sandy loam	SM, SM–SC	A-2-4, A-4, or A-6	0
Genesee: **Ge**	>4	0–12	Silt loam	CL or ML	A-4 or A-6	0
		12–54	Silt loam, loam	CL or ML	A-4 or A-6	0
		54–60	Sandy loam, loamy sand	SM, SM–SC	A-2-4, A-4	0
Kokomo: **Ko**	0–1 or ponded	0–11	Silty clay loam	CL or CH	A-7 or A-6	0
		11–44	Silty clay loam, clay loam	CL or CH	A-6 or A-7	0
		44–60	Loam	CL	A-4 or A-6	0–3
Martinsville: **MaA, MaB2**	>4	0–13	Loam	CL, CL–ML	A-4 or A-6	0
		13–54	Clay loam, sandy clay loam, sandy loam.	CL, CL–ML, or SM–SC	A-4, A-2, or A-6	0
		54–60	Sand and silt loam	SM–SC or SC	A-4 or A-2-4	0
Miami:						
MmA, MmB2, MmC2, MmD2	>4	0–6	Silt loam	CL, CL–ML, or CL	A-4 or A-6	0
		6–33	Clay loam	CL	A-6 or A-7	0
		33–60	Loam	ML, CL–ML, or CL	A-4 or A-6	0–3
MpC3, MpD3	>4	0–6	Clay loam	CL	A-6 or A-7	0
		6–23	Clay loam	CL	A-6 or A-7	0
		23–60	Loam	ML, CL–ML, or CL	A-4 or A-6	0–3
Milford: **Mr**	0–1 or ponded	0–9	Silty clay loam	CL or CH	A-7	0
		9–40	Silty clay and silty clay loam.	CL or CH	A-7	0
		40–60	Silty clay loam, silt loam	CL	A-7 or A-6	0
Ockley: **OcA, OcB2, OkC2**	>4	0–13	Silt loam, loam	CL or CL–ML	A-4 or A-6	0
		13–21	Clay loam	CL	A-4 or A-6	0
		21–49	Gravelly clay loam	CL or SC	A-6 or A-7	0–2
		49–60	Gravelly sand	SP, SP–SM, GP, or GP–GM	A-1-b	1–5
Palms: **Ps**	0–1 or ponded	0–30	Muck	Pt		0
		30–45	Loam	CL–ML or CL	A-4 or A-6	0–3
		45–60	Gravelly loamy sand	SP–SM or SM	A-1-b or A-2	0–5
Rensselaer: **Re**	0–1 or ponded	0–11	Silty clay loam	CL or CH	A-6 or A-7	0
		11–42	Clay loam, silty clay loam	CL	A-6 or A-7	0
		42–60	Silt loam, sandy loam, clay loam, and sand.	CL–ML, CL, SM–SC, or SC	A-4	0
Shoals: **Sh**	1–3	0–11	Silt loam	CL or CL–ML	A-4 or A-6	0
		11–60	Loam, silt loam, clay loam, and sandy loam.	ML	A-4	0–3
Sloan: **So**	0–1 or ponded	0–13	Silty clay loam	ML or CL	A-4, A-5, A-6, or A-7	0
		13–34	Clay loam, loam	ML or CL	A-6 or A-7	0
		34–60	Sandy loam, loam, loamy sand.	CL–ML or CL	A-4 or A-6	0

Engineering Soil Properties (2).

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
						In per hour	*In per in of soil*	*pH*		
100	98–100	95–100	75–95	36–48	15–20	0.6–2.0	0.21–0.23	6.1–7.3	High	Moderate.
98–100	96–100	85–95	75–85	36–52	18–30	0.6–2.0	0.15–0.19	6.1–7.8		Moderate.
90–100	85–95	78–90	55–70	22–30	7–15	0.2–0.6	0.05–0.19	7.4–8.4		Moderate.
100	95–100	80–100	50–90	22–34	6–15	0.6–2.0	0.22–0.24	5.6–6.5	High	Low.
92–99	90–97	78–90	65–75	37–50	17–31	0.06–0.2	0.15–0.19	5.1–7.8		Moderate.
90–94	85–89	75–87	50–64	17–30	2–14	0.06–0.2	0.05–0.19	7.9–8.4		Low.
100	100	90–100	75–85	26–36	6–15	0.6–2.0	0.22–0.24	6.1–7.3	High	Low.
100	100	90–100	75–85	26–40	5–15	0.6–2.0	0.17–0.21	6.6–7.3		Low.
100	90–100	50–70	10–40	15–25	[1]NP-5	0.6–2.0	0.05–0.13	6.6–8.4		Low.
100	100	90–100	75–85	26–36	6–15	0.6–2.0	0.22–0.24	6.1–7.8	Moderate	Low.
100	100	90–100	75–85	26–40	5–15	0.6–2.0	0.17–0.21	6.6–8.4		Low.
100	90–100	50–70	10–40	15–25	NP-5	0.6–2.0	0.05–0.13	6.6–8.4		Low.
100	98–100	85–95	75–85	35–55	15–30	0.6–2.0	0.21–0.23	6.1–7.3	High	Moderate.
98–100	98–100	95–100	75–95	38–55	15–30	0.06–0.2	0.18–0.20	6.1–8.4		Moderate.
90–100	85–95	75–90	55–70	25–35	10–20	0.06–0.2	0.05–0.19	7.9–8.4		Low.
100	95–100	80–100	60–85	22–33	4–12	0.6–2.0	0.20–0.22	5.1–6.5	Moderate	Low.
100	95–100	65–90	30–80	20–35	6–17	0.6–2.0	0.15–0.19	5.1–7.8		Low.
98–100	95–100	50–90	10–50	15–25	4–9	2.0–6.0	0.19–0.21	7.4–8.4		Low.
100	95–100	85–100	50–90	23–34	6–15	0.6–2.0	0.22–0.24	5.6–7.3	Moderate	Low.
92–99	90–97	80–95	65–95	37–50	17–31	0.6–2.0	0.15–0.19	5.1–7.8		Moderate.
90–94	85–90	75–85	50–64	17–30	2–14	0.2–0.6	0.05–0.19	7.9–8.4		Low.
95–100	90–100	80–100	65–85	35–50	15–30	0.6–2.0	0.22–0.24	5.6–7.3	Moderate	Low.
92–99	90–97	80–95	65–95	37–50	17–31	0.6–2.0	0.15–0.19	5.1–7.8		Moderate.
90–94	85–90	75–85	50–64	17–30	2–14	0.2–0.6	0.05–0.19	7.8–8.4		Low.
100	100	95–99	90–99	42–58	19–32	0.2–0.6	0.21–0.23	6.1–7.3	High	High.
100	100	95–99	85–99	41–61	23–38	0.2–0.6	0.12–0.18	6.6–8.4		High.
100	98–100	90–99	70–99	34–50	15–31	0.2–0.6	0.15–0.20	7.4–8.4		Moderate.
100	95–100	80–100	60–90	22–33	4–12	0.6–2.0	0.22–0.24	5.6–7.3	Moderate	Low.
100	75–100	65–90	50–90	20–35	8–17	0.6–2.0	0.15–0.20	5.1–6.5		Moderate.
70–85	45–75	40–70	35–55	30–45	11–25	0.6–2.0	0.12–0.14	5.6–6.5		Moderate.
30–70	25–55	7–20	2–10	<2	0	>20	0.02–0.04	7.9–8.4		Low.
						>20	>0.35–0.45	5.1–8.4	High	High.
95–100	95–100	80–95	55–75	12–30	6–12	0.2–2.0	0.17–0.19	6.1–8.4		Low.
70–75	65–75	35–55	10–25	<5	NP	0.2–2.0	0.05–0.07	6.1–8.4		Low.
100	100	95–100	85–95	40–54	20–32	0.2–0.6	0.21–0.23	6.1–7.3	High	Moderate.
100	100	90–100	70–80	33–47	15–26	0.06–0.2	0.15–0.19	6.1–7.8		Moderate.
98–100	98–100	95–100	40–60	<30	4–9	0.06–0.2	0.19–0.21	7.4–8.4		Low.
100	100	90–100	65–90	22–36	6–15	0.6–2.0	0.22–0.24	6.1–7.3	High	Low.
95–100	90–100	70–80	55–70	32–40	3–8	0.6–2.0	0.19–0.21	6.6–8.4		Low.
100	100	90–100	85–95	30–45	8–15	0.6–2.0	0.21–0.23	6.1–7.8	High	Moderate.
100	90–100	85–95	75–95	30–45	11–18	0.6–2.0	0.17–0.19	6.6–7.8		Moderate.
95–100	90–100	80–95	65–90	25–35	6–15	0.6–2.0	0.08–0.13	6.6–8.4		Low.

Appendix B –

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Ft	*In*				*Pct*
Westland: We	0–1 or ponded	0–11	Clay loam	CL	A–6	0
		11–32	Clay loam, silty clay loam	CL	A–6	0
		32–48	Gravelly clay loam, gravelly loam.	CL	A–6	0–3
		48–60	Very gravelly loamy sand	GP, GP–GM, SP, or SP–SM	A–1–b	1–5
Whitaker: Wh	1–3	0–11	Loam	CL or CL–ML	A–4 or A–6	0
		11–56	Clay loam, sandy clay loam, loam, and sandy loam.	CL or SC	A–6 or A–7	0
		56–60	Sandy loam, loamy sand, and sand.	CL, ML, CL–ML, or SM–SC	A–4	0

[1] NP = Nonplastic.

Appendix C – Engineering Interpretations

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Brookston: Br	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Crosby: CrA	Fair: 8 to 14 inches of suitable material.	Unsuited	Poor: high potential frost action; fair to poor compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; good to fair compaction characteristics.
Eel: Ee	Good	Unsuited[1]	Poor: high potential frost action; fair compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Genesee: Ge	Good	Unsuited[1]	Fair: moderate potential frost action; fair to poor shear strength; fair compaction characteristics and stability.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Kokomo: Ko	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair to poor compaction characteristics.
Martinsville: MaA, MaB2.	Fair: 6 to 15 inches of suitable material.	Unsuited for gravel; sand below a depth of 60 inches in some places.	Fair: moderate potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Medium to low shear strength; low to medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Fair where slopes are 0 12 percent: 6 to 12 inches of suitable material. Poor where slopes are 12 to 18 percent: hazard of erosion.	Unsuited	Fair: moderate frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; fair compaction characteristics.

Appendix B – Table of Estimated Engineering Soil Properties (2).

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches	Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action	Shrink-swell potential
				Unified	AASHTO		No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
	Ft	*In*				*Pct*							*In per hour*	*In per in of soil*	*pH*		
Brookston: Br	0-1 or ponded	0-12	Silty clay loam	CL	A-6 or A-7	0	100	98-100	95-100	75-95	36-48	15-20	0.6-2.0	0.21-0.23	6.1-7.3	High	Moderate.
		12-54	Clay loam	CL or CH	A-6 or A-7	0	98-100	96-100	85-95	75-85	36-52	18-30	0.6-2.0	0.15-0.19	6.1-7.8		Moderate.
		54-60	Loam	CL	A-4 or A-6	0-3	90-100	85-95	78-90	55-70	22-30	7-15	0.2-0.6	0.05-0.19	7.4-8.4		Moderate.
Crosby: CrA	1-3	0-12	Silt loam	CL-ML or CL	A-4 or A-6	0	100	95-100	80-100	50-90	22-34	6-15	0.6-2.0	0.22-0.24	5.6-6.5	High	Low.
		12-40	Clay loam	CL	A-6 or A-7	0-2	92-99	90-97	78-90	65-75	37-50	17-31	0.06-0.2	0.15-0.19	5.1-7.8		Moderate.
		40-60	Loam	ML, CL-ML, or CL	A-4 or A-6	0-3	90-94	85-89	75-87	50-64	17-30	2-14	0.06-0.2	0.05-0.19	7.9-8.4		Low.
Eel: Ea	2-4	0-12	Silt loam	CL or CL-ML	A-4 or A-6	0	100	100	90-100	75-85	26-36	6-15	0.6-2.0	0.22-0.24	6.1-7.3	High	Low.
		12-39	Silt loam, loam, clay loam	CL or ML	A-4 or A-6	0	100	100	90-100	75-85	26-40	5-15	0.6-2.0	0.17-0.21	6.6-7.3		Low.
		39-60	Sand, sandy loam	SM, SM-SC	A-2-4, A-4, or A-6	0	100	90-100	50-70	10-40	15-25	[1]NP-5	0.6-2.0	0.05-0.13	6.6-8.4		Low.
Genesee: Ge	>4	0-12	Silt loam	CL or ML	A-4 or A-6	0	100	100	90-100	75-85	26-36	6-15	0.6-2.0	0.22-0.24	6.1-7.8	Moderate	Low.
		12-54	Silt loam, loam	CL or ML	A-4 or A-6	0	100	100	90-100	75-85	26-40	5-15	0.6-2.0	0.17-0.21	6.6-8.4		Low.
		54-60	Sandy loam, loamy sand	SM, SM-SC	A-2-4, A-4	0	100	90-100	50-70	10-40	15-25	NP-5	0.6-2.0	0.05-0.13	6.6-8.4		Low.
Kokomo: Ko	0-1 or ponded	0-11	Silty clay loam	CL or CH	A-7 or A-6	0	100	98-100	85-95	75-85	35-55	15-30	0.6-2.0	0.21-0.23	6.1-7.3	High	Moderate.
		11-44	Silty clay loam, clay loam	CL or CH	A-6 or A-7	0	98-100	98-100	95-100	75-95	38-55	15-30	0.06-0.2	0.18-0.20	6.1-8.4		Moderate.
		44-60	Loam	CL	A-4 or A-6	0-3	90-100	85-95	75-90	55-70	25-35	10-20	0.06-0.2	0.05-0.19	7.9-8.4		Low.
Martinsville: MaA, MaB2	>4	0-13	Loam	CL, CL-ML	A-4 or A-6	0	100	95-100	80-100	60-85	22-33	4-12	0.6-2.0	0.20-0.22	5.1-6.5	Moderate	Low.
		13-54	Clay loam, sandy clay loam, sandy loam.	CL, CL-ML, or SM-SC	A-4, A-2, or A-6	0	100	95-100	65-90	30-80	20-35	6-17	0.6-2.0	0.15-0.19	5.1-7.8		Low.
		54-60	Sand and silt loam	SM-SC or SC	A-4 or A-2-4	0	98-100	95-100	50-90	10-50	15-25	4-9	2.0-6.0	0.19-0.21	7.4-8.4		Low.
Miami:																	
MmA, MmB2, MmC2, MmD2	>4	0-6	Silt loam	CL, CL-ML, or CL	A-4 or A-6	0	100	95-100	85-100	50-90	23-34	6-15	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low.
		6-33	Clay loam	CL	A-6 or A-7	0	92-99	90-97	80-95	65-95	37-50	17-31	0.6-2.0	0.15-0.19	5.1-7.8		Moderate.
		33-60	Loam	ML, CL-ML, or CL	A-4 or A-6	0-3	90-94	85-90	75-85	50-64	17-30	2-14	0.2-0.6	0.05-0.19	7.9-8.4		Low.
MpC3, MpD3	>4	0-6	Clay loam	CL	A-6 or A-7	0	95-100	90-100	80-100	65-85	35-50	15-30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low.
		6-23	Clay loam	CL	A-6 or A-7	0	92-99	90-97	80-95	65-95	37-50	17-31	0.6-2.0	0.15-0.19	5.1-7.8		Moderate.
		23-60	Loam	ML, CL-ML, or CL	A-4 or A-6	0-3	90-94	85-90	75-85	50-64	17-30	2-14	0.2-0.6	0.05-0.19	7.8-8.4		Low.
Milford: Mr	0-1 or ponded	0-9	Silty clay loam	CL or CH	A-7	0	100	100	95-99	90-99	42-58	19-32	0.2-0.6	0.21-0.23	6.1-7.3	High	High.
		9-40	Silty clay and silty clay loam.	CL or CH	A-7	0	100	100	95-99	85-99	41-61	23-38	0.2-0.6	0.12-0.18	6.6-8.4		High.
		40-60	Silty clay loam, silt loam	CL	A-7 or A-6	0	100	98-100	90-99	70-99	34-50	15-31	0.2-0.6	0.15-0.20	7.4-8.4		Moderate.
Ockley: OcA, OcB2, OkC2	>4	0-13	Silt loam, loam	CL or CL-ML	A-4 or A-6	0	100	95-100	80-100	60-90	22-33	4-12	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low.
		13-21	Clay loam	CL	A-4 or A-6	0	100	75-100	65-90	50-90	20-35	8-17	0.6-2.0	0.15-0.20	5.1-6.5		Moderate.
		21-49	Gravelly clay loam	CL or SC	A-6 or A-7	0-2	70-85	45-75	40-70	35-55	30-45	11-25	0.6-2.0	0.12-0.14	5.6-6.5		Moderate.
		49-60	Gravelly sand	SP, SP-SM, GP, or GP-GM	A-1-b	1-5	30-70	25-55	7-20	2-10	<2	0	>20	0.02-0.04	7.9-8.4		Low.
Palms: Ps	0-1 or ponded	0-30	Muck	Pt		0							>20	>0.35-0.45	5.1-8.4	High	High.
		30-45	Loam	CL-ML or CL	A-4 or A-6	0-3	95-100	95-100	80-95	55-75	12-30	6-12	0.2-2.0	0.17-0.19	6.1-8.4		Low.
		45-60	Gravelly loamy sand	SP-SM or SM	A-1-b or A-2	0-5	70-75	65-75	35-55	10-25	<5	NP	0.2-2.0	0.05-0.07	6.1-8.4		Low.
Rensselaer: Re	0-1 or ponded	0-11	Silty clay loam	CL or CH	A-6 or A-7	0	100	100	95-100	85-95	40-54	20-32	0.2-0.6	0.21-0.23	6.1-7.3	High	Moderate.
		11-42	Clay loam, silty clay loam	CL	A-6 or A-7	0	100	100	90-100	70-80	33-47	15-26	0.06-0.2	0.15-0.19	6.1-7.8		Moderate.
		42-60	Silt loam, sandy loam, clay loam, and sand.	CL-ML, CL, SM-SC, or SC	A-4	0	98-100	98-100	95-100	40-60	<30	4-9	0.06-0.2	0.19-0.21	7.4-8.4		Low.
Shoals: Sh	1-3	0-11	Silt loam	CL or CL-ML	A-4 or A-6	0	100	100	90-100	65-90	22-36	6-15	0.6-2.0	0.22-0.24	6.1-7.3	High	Low.
		11-60	Loam, silt loam, clay loam, and sandy loam.	ML	A-4	0-3	95-100	90-100	70-80	55-70	32-40	3-8	0.6-2.0	0.19-0.21	6.6-8.4		Low.
Sloan: So	0-1 or ponded	0-13	Silty clay loam	ML or CL	A-4, A-5, A-6, or A-7	0	100	100	90-100	85-95	30-45	8-15	0.6-2.0	0.21-0.23	6.1-7.8	High	Moderate.
		13-34	Clay loam, loam	ML or CL	A-6 or A-7	0	100	90-100	85-95	75-95	30-45	11-18	0.6-2.0	0.17-0.19	6.6-7.8		Moderate.
		34-60	Sandy loam, loam, loamy sand.	CL-ML or CL	A-4 or A-6	0	95-100	90-100	80-95	65-90	25-35	6-15	0.6-2.0	0.08-0.13	6.6-8.4		Low.

Appendix B -

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Ft	*In*				*Pct*
Westland: We	0-1 or ponded	0-11	Clay loam	CL	A-6	0
		11-32	Clay loam, silty clay loam	CL	A-6	0
		32-48	Gravelly clay loam, gravelly loam.	CL	A-6	0-3
		48-60	Very gravelly loamy sand	GP, GP-GM, SP, or SP-SM	A-1-b	1-5
Whitaker: Wh	1-3	0-11	Loam	CL or CL-ML	A-4 or A-6	0
		11-56	Clay loam, sandy clay loam, loam, and sandy loam.	CL or SC	A-6 or A-7	0
		56-60	Sandy loam, loamy sand, and sand.	CL, ML, CL-ML, or SM-SC	A-4	0

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[1] NP = Nonplastic.

Appendix C — Engineering Interpretations

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Brookston: Br	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Crosby: CrA	Fair: 8 to 14 inches of suitable material.	Unsuited	Poor: high potential frost action; fair to poor compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; good to fair compaction characteristics.
Eel: Ee	Good	Unsuited[1]	Poor: high potential frost action; fair compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Genesee: Ge	Good	Unsuited[1]	Fair: moderate potential frost action; fair to poor shear strength; fair compaction characteristics and stability.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Kokomo: Ko	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair to poor compaction characteristics.
Martinsville: MaA, MaB2.	Fair: 6 to 15 inches of suitable material.	Unsuited for gravel; sand below a depth of 60 inches in some places.	Fair: moderate potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Medium to low shear strength; low to medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Fair where slopes are 0 12 percent: 6 to 12 inches of suitable material. Poor where slopes are 12 to 18 percent: hazard of erosion.	Unsuited	Fair: moderate frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; fair compaction characteristics.

- Continued.

Percentage passing sieve— No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action	Shrink-swell potential
						In per hour	*In per in of soil*	*pH*		
95–100	90–100	85–95	65–75	27–38	11–20	0.6–2.0	0.18–0.21	6.1–7.3	High	Moderate.
95–100	90–100	80–90	65–75	30–40	20–30	0.06–0.2	0.16–0.19	6.1–7.3		Moderate.
65–75	60–70	55–70	50–70	30–40	20–30	0.06–0.2	0.10–0.12	6.1–8.4		Moderate.
40–70	25–55	10–20	2–10	0	NP	>20	0.02–0.04	7.9–8.4		Low.
100	95–100	85–100	60–90	22–33	4–12	0.6–2.0	0.20–0.22	5.6–7.3	High	Low.
98–100	95–100	50–85	40–60	30–47	12–26	0.6–2.0	0.15–0.18	5.1–8.4		Moderate.
98–100	95–100	90–100	35–60	15–21	4–9	0.6–2.0	0.05–0.07	7.9–8.4		Low.

of the Pedalogical Soil Series (2).

Soil features affecting—Cont. Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Seasonal high water table at a depth of 0 to 1 foot, or ponded; underlying material has moderately slow permeability; suitable for pit-type ponds.	Underlying material has moderately slow permeability; depressional; very poorly drained; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded.	Generally not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 1 foot to 3 feet; slow permeability; most areas suitable for pit-type ponds.	Somewhat poorly drained; slow permeability.	Generally not needed; runoff slow; features are favorable.	Generally not needed; features are favorable; moderately erodible.
Seasonal high water table at a depth of 2 to 4 feet; underlain by sand and gravel; not suitable in most areas.	Moderately well drained; moderate permeability; subject to occasional flooding.	Generally not needed; nearly level; runoff slow.	Generally not needed; nearly level; runoff slow.
Moderate permeability; deep to water table; underlain by sand and gravel; seepage.	Well drained; moderate permeability; subject to occasional flooding.	Generally not needed; nearly level; runoff slow.	Generally not needed; nearly level; runoff slow.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability; suitable for pit-type ponds.	Very poorly drained; slow permeability; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded; very poorly drained.	Not needed; depressional; runoff very slow or ponded; very poorly drained.
Moderate permeability; deep to water table; underlain by permeable sand; seepage.	Well drained	Generally not needed; slopes are generally short; runoff slow or medium; features favorable.	Features are favorable.
Moderately slow permeability; deep to water table; slope hinders pit-type ponds; some areas where slopes are 6 to 18 percent are suitable for pit-type ponds.	Well drained; small seeps in some places; on severely eroded areas the clay loam surface layer does not dry as fast.	Features are favorable where slopes are 0 to 2 percent: generally not needed. Moderate erosion hazard where slopes are 2 to 12 percent. Unsuitable where slopes are 12 to 18 percent.	Features are favorable; slopes of more than 6 percent erode easily; runoff medium to rapid.

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Milford: Mr	Poor: very poorly drained.	Unsuited	Poor: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Ockley: OcA, OcB2, OkC2.	Fair: 8 to 13 inches of suitable material.	Good	Fair: moderate frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength and compressibility; medium to low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Palms: Ps	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable.	Muck is unsuited. Underlying material has medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; and fair compaction characteristics.
Rensselaer: Re	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics; moderate shrink-swell.
Shoals: Sn	Good	Unsuited[1]	Poor: high potential frost action; fair to good shear strength and compaction characteristics; medium to high compressibility.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Sloan: So	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Westland: We	Poor: very poorly drained.	Good	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength; medium to low compressibility; low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Whitaker: Wh	Good	Poor	Poor: high potential frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.

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[1] These soils are underlain by sand and gravel at a depth below 5 feet in some areas.

Appendix B – Continued.

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches	Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action	Shrink-swell potential
				Unified	AASHTO		No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
	Ft	*In*				*Pct*							*In per hour*	*In per in of soil*	*pH*		
Westland: We	0–1 or ponded	0–11	Clay loam	CL	A–6	0	95–100	90–100	85–95	65–75	27–38	11–20	0.6–2.0	0.18–0.21	6.1–7.3	High	Moderate.
		11–32	Clay loam, silty clay loam	CL	A–6	0	95–100	90–100	80–90	65–75	30–40	20–30	0.06–0.2	0.16–0.19	6.1–7.3		Moderate.
		32–48	Gravelly clay loam, gravelly loam.	CL	A–6	0–3	65–75	60–70	55–70	50–70	30–40	20–30	0.06–0.2	0.10–0.12	6.1–8.4		Moderate.
		48–60	Very gravelly loamy sand	GP, GP–GM, SP, or SP–SM	A–1–b	1–5	40–70	25–55	10–20	2–10	0	NP	>20	0.02–0.04	7.9–8.4		Low.
Whitaker: Wh	1–3	0–11	Loam	CL or CL–ML	A–4 or A–6	0	100	95–100	85–100	60–90	22–33	4–12	0.6–2.0	0.20–0.22	5.6–7.3	High	Low.
		11–56	Clay loam, sandy clay loam, loam, and sandy loam.	CL or SC	A–6 or A–7	0	98–100	95–100	50–85	40–60	30–47	12–26	0.6–2.0	0.15–0.18	5.1–8.4		Moderate.
		56–60	Sandy loam, loamy sand. and sand.	CL, ML, CL–ML, or SM–SC	A–4	0	98–100	95–100	90–100	35–60	15–21	4–9	0.6–2.0	0.05–0.07	7.9–8.4		Low.

[1] NP = Nonplastic.

Appendix C – Engineering Interpretations of the Pedalogical Soil Series (2).

Soil series and map symbols	Suitability as source of—			Soil features affecting—	Soil features affecting—Cont.			
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees	Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Brookston: Br	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.	Seasonal high water table at a depth of 0 to 1 foot, or ponded; underlying material has moderately slow permeability; suitable for pit-type ponds.	Underlying material has moderately slow permeability; depressional; very poorly drained; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded.	Generally not needed; depressional; very poorly drained.
Crosby: CrA	Fair: 8 to 14 inches of suitable material.	Unsuited	Poor: high potential frost action; fair to poor compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; good to fair compaction characteristics.	Seasonal high water table at a depth of 1 foot to 3 feet; slow permeability; most areas suitable for pit-type ponds.	Somewhat poorly drained; slow permeability.	Generally not needed; runoff slow; features are favorable.	Generally not needed; features are favorable; moderately erodible.
Eel: Ea	Good	Unsuited[1]	Poor: high potential frost action; fair compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.	Seasonal high water table at a depth of 2 to 4 feet; underlain by sand and gravel; not suitable in most areas.	Moderately well drained; moderate permeability; subject to occasional flooding.	Generally not needed; nearly level; runoff slow.	Generally not needed; nearly level; runoff slow.
Genesee: Ge	Good	Unsuited[1]	Fair: moderate potential frost action; fair to poor shear strength; fair compaction characteristics and stability.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.	Moderate permeability; deep to water table; underlain by sand and gravel; seepage.	Well drained; moderate permeability; subject to occasional flooding.	Generally not needed; nearly level; runoff slow.	Generally not needed; nearly level; runoff slow.
Kokomo: Ko	Poor: very poorly drained.	Unsuited.	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair to poor compaction characteristics.	Seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability; suitable for pit-type ponds.	Very poorly drained; slow permeability; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded; very poorly drained.	Not needed; depressional; runoff very slow or ponded; very poorly drained.
Martinsville: MaA, MaB2.	Fair: 6 to 15 inches of suitable material.	Unsuited for gravel; sand below a depth of 60 inches in some places.	Fair: moderate potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Medium to low shear strength; low to medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.	Moderate permeability; deep to water table; underlain by permeable sand; seepage.	Well drained	Generally not needed; slopes are generally short; runoff slow or medium; features favorable.	Features are favorable.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Fair where slopes are 0 12 percent: 6 to 12 inches of suitable material. Poor where slopes are 12 to 18 percent: hazard of erosion.	Unsuited	Fair: moderate frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; fair compaction characteristics.	Moderately slow permeability; deep to water table; slope hinders pit-type ponds; some areas where slopes are 6 to 18 percent are suitable for pit-type ponds.	Well drained; small seeps in some places; on severely eroded areas the clay loam surface layer does not dry as fast.	Features are favorable where slopes are 0 to 2 percent: generally not needed. Moderate erosion hazard where slopes are 2 to 12 percent. Unsuitable where slopes are 12 to 18 percent.	Features are favorable; slopes of more than 6 percent erode easily; runoff medium to rapid.

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Milford: Mr	Poor: very poorly drained.	Unsuited	Poor: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Ockley: OcA, OcB2, OkC2.	Fair: 8 to 13 inches of suitable material.	Good	Fair: moderate frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength and compressibility; medium to low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Palms: Ps	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable.	Muck is unsuited. Underlying material has medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; and fair compaction characteristics.
Rensselaer: Re	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics; moderate shrink-swell.
Shoals: Sn	Good	Unsuited[1]	Poor: high potential frost action; fair to good shear strength and compaction characteristics; medium to high compressibility.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Sloan: So	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Westland: We	Poor: very poorly drained.	Good	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength; medium to low compressibility; low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Whitaker: Wh	Good	Poor	Poor: high potential frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.

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[1] These soils are underlain by sand and gravel at a depth below 5 feet in some areas.

Soil features affecting—Cont.			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Moderately slow permeability; seasonal high water table at a depth of 0 to 1 foot, or ponded; suitable for pit-type ponds.	Poorly drained; moderately slow permeability; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded; poorly drained.	Not needed; depressional; runoff very slow or ponded; poorly drained.
Moderate permeability; deep to water table; underlain by sand and gravel; seepage.	Well drained.	Features are favorable where slopes are 0 to 12 percent: generally not needed; gravelly subsoil.	Features are favorable where slopes are 0 to 12 percent: generally not needed; runoff moderate to rapid; erodes easily.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; most areas are suited to pit-type ponds where water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable; generally poor outlets.	Not needed; depressional; very poorly drained.	Not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; some undrained areas are suitable for pit-type ponds where water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; sand and silt below a depth of 4 feet need special attention.	Not needed; depressional; very poorly drained.	Not needed; depressional very poorly drained.
Seasonal high water table at a depth of 1 foot to 3 feet; subject to occasional flooding.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; subject to occasional flooding; sand and silt below a depth of 4 feet need special attention.	Not needed; features are favorable.	Generally not needed; features are favorable.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability; subject to flooding; undrained areas are suitable for pit-type ponds where the water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; subject to flooding; sand and silt below a depth of 4 feet need special attention; usually poor outlets.	Generally not needed; depressional; very poorly drained.	Generally not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; underlain by sand and gravel; most undrained areas are suitable for pit-type ponds.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; sand and gravel below a depth of 4 feet need special attention.	Generally not needed; depressional; very poorly drained.	Generally not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; underlain by sand; seepage.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; silt and sand below a depth of 4 feet need special attention.	Features are favorable; generally not needed.	Features are favorable; generally not needed.

Appendix D – Soil Limitations for

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Brookston: Br	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Crosby: CrA	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Slight
Eel: Ee	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Genesee: Ge	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Kokomo: Ko	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artifically drained.
Martinsville: MaA, MaB2.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development.	Slight
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development. Severe where slopes are 6 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: hazard of erosion; slope hinders development and maintenance. Severe where slopes are 12 to 18 percent: hazard of erosion; slope hinders development.
Milford: Mr	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe if undrained: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Ockley: OcA, OcB2, OkC2.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Moderate: moderate shrink-swell.	Moderate where slopes are 0 to 6 percent: moderate shrink-swell. Severe where slopes are 6 to 12 percent: slope hinders development.	Slight
Palms: Ps	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe- very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.

Appendix C – Continued.

Soil series and map symbols	Suitability as source of—			Soil features affecting—	Soil features affecting—Cont.			
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees	Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Milford: Mr	Poor: very poorly drained.	Unsuited	Poor: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.	Moderately slow permeability; seasonal high water table at a depth of 0 to 1 foot, or ponded; suitable for pit-type ponds.	Poorly drained; moderately slow permeability; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded; poorly drained.	Not needed; depressional; runoff very slow or ponded; poorly drained.
Ockley: OcA, OcB2, OkC2.	Fair: 8 to 13 inches of suitable material.	Good	Fair: moderate frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength and compressibility; medium to low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.	Moderate permeability; deep to water table; underlain by sand and gravel; seepage.	Well drained	Features are favorable where slopes are 0 to 12 percent: generally not needed; gravelly subsoil.	Features are favorable where slopes are 0 to 12 percent: generally not needed; runoff moderate to rapid; erodes easily.
Palms: Ps	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable.	Muck is unsuited. Underlying material has medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; and fair compaction characteristics.	Seasonal high water table at a depth of 0 to 1 foot, or ponded; most areas are suited to pit-type ponds where water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable; generally poor outlets.	Not needed; depressional; very poorly drained.	Not needed; depressional; very poorly drained.
Rensselaer: Re	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics; moderate shrink-swell.	Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; some undrained areas are suitable for pit-type ponds where water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; sand and silt below a depth of 4 feet need special attention.	Not needed; depressional; very poorly drained.	Not needed; depressional very poorly drained.
Shoals: Sn	Good	Unsuited[1]	Poor: high potential frost action; fair to good shear strength and compaction characteristics; medium to high compressibility.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.	Seasonal high water table at a depth of 1 foot to 3 feet; subject to occasional flooding.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; subject to occasional flooding; sand and silt below a depth of 4 feet need special attention.	Not needed; features are favorable.	Generally not needed; features are favorable.
Sloan: So	Poor: very poorly drained.	Unsuited[1]	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.	Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability; subject to flooding; undrained areas are suitable for pit-type ponds where the water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; subject to flooding; sand and silt below a depth of 4 feet need special attention; usually poor outlets.	Generally not needed; depressional; very poorly drained.	Generally not needed; depressional; very poorly drained.
Westland: We	Poor: very poorly drained.	Good	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength; medium to low compressibility; low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.	Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; underlain by sand and gravel; most undrained areas are suitable for pit-type ponds.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; sand and gravel below a depth of 4 feet need special attention.	Generally not needed; depressional; very poorly drained.	Generally not needed; depressional; very poorly drained.
Whitaker: Wh	Good	Poor	Poor: high potential frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.	Seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; underlain by sand; seepage.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; silt and sand below a depth of 4 feet need special attention.	Features are favorable; generally not needed.	Features are favorable; generally not needed.

[1] These soils are underlain by sand and gravel at a depth below 5 feet in some areas.

Appendix D – Soil Limitations for

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Brookston: Br	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Crosby: CrA	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Slight.
Eel: Ee	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Genesee: Ge	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Kokomo: Ko	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artifically drained.
Martinsville: MaA, MaB2.	Slight.	Slight.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development.	Slight.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development. Severe where slopes are 6 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: hazard of erosion; slope hinders development and maintenance. Severe where slopes are 12 to 18 percent: hazard of erosion; slope hinders development.
Milford: Mr	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe if undrained: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Ockley: OcA, OcB2, OkC2.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Moderate: moderate shrink-swell.	Moderate where slopes are 0 to 6 percent: moderate shrink-swell. Severe where slopes are 6 to 12 percent: slope hinders development.	Slight.
Palms: Ps	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe- very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.

Town and Country Planning (2).

Local roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.[1]	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: slow permeability; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Slight.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; clay loam texture moderately affects workability.
Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.[1]	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; silty clay texture severely affects workability.
Moderate: moderate potential frost action; moderate to low shrink-swell.	Slight.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 5 feet; hazard of leachate flow to ground water.
Moderate where slopes are 0 to 12 percent: moderate potential frost action. Severe where slopes are 12 to 18 percent: slope hinders development.	Moderate where slopes are 0 to 12 percent: moderately slow permeability; slope causes moderate hazard of effluent seepage. Severe where slopes are 12 to 18 percent: severe hazard of erosion and effluent seepage.	Moderate where slopes are 0 to 6 percent: moderate hazard of effluent seepage; slopes of 2 to 6 percent moderately hinder development. Severe where slopes are 6 to 18 percent: slope severely hinders development.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent: slope moderately hinders development.
Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: moderately slow permeability; poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.[1]	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; silty clay texture severely affects workability.
Moderate: moderate potential frost action; moderate shrink-swell.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope causes moderate hazard of effluent seepage.	Severe: less than 5 feet deep to rapidly permeable sand and gravel; severe hazard of effluent seepage to ground water.	Severe: less than 5 feet deep to rapidly permeable sand and gravel; severe hazard of leachate flow to ground water.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility; high potential frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material does not provide satisfactory cover.

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Rensselaer: Re	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Shoals: Sh	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding.
Sloan: So	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Westland: We	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Whitaker: Wh	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Slight

[1] If floor of the lagoon is nearly impermeable material at least 2 feet thick, depth to water table can be disregarded.

Appendix D — Soil Limitations for Town and Country Planning (2).

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns	Local roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Brookston: Br	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.[1]	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Crosby: CrA	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Slight	Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: slow permeability; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Slight	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; clay loam texture moderately affects workability.
Eel: Ee	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Genesee: Ge	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Kokomo: Ko	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artifically drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.[1]	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; silty clay texture severely affects workability.
Martinsville: MaA, MaB2.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development.	Slight	Moderate: moderate potential frost action; moderate to low shrink-swell.	Slight	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 5 feet; hazard of leachate flow to ground water.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development. Severe where slopes are 6 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: hazard of erosion; slope hinders development and maintenance. Severe where slopes are 12 to 18 percent: hazard of erosion; slope hinders development.	Moderate where slopes are 0 to 12 percent: moderate potential frost action. Severe where slopes are 12 to 18 percent: slope hinders development.	Moderate where slopes are 0 to 12 percent: moderately slow permeability; slope causes moderate hazard of effluent seepage. Severe where slopes are 12 to 18 percent: severe hazard of erosion and effluent seepage.	Moderate where slopes are 0 to 6 percent: moderate hazard of effluent seepage; slopes of 2 to 6 percent moderately hinder development. Severe where slopes are 6 to 18 percent: slope severely hinders development.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent: slope moderately hinders development.
Milford: Mr	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe if undrained: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: moderately slow permeability; poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.[1]	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; silty clay texture severely affects workability.
Ockley: OcA, OcB2, OkC2.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Moderate: moderate shrink-swell.	Moderate where slopes are 0 to 6 percent: moderate shrink-swell. Severe where slopes are 6 to 12 percent: slope hinders development.	Slight	Moderate: moderate potential frost action; moderate shrink-swell.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope causes moderate hazard of effluent seepage.	Severe: less than 5 feet deep to rapidly permeable sand and gravel; severe hazard of effluent seepage to ground water.	Severe: less than 5 feet deep to rapidly permeable sand and gravel; severe hazard of leachate flow to ground water.
Palms: Ps	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility; high potential frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material does not provide satisfactory cover.

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Rensselaer: Re	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Shoals: Sh	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding.
Sloan: So	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Westland: We	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Whitaker: Wh	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Slight.

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[1] If floor of the lagoon is nearly impermeable material at least 2 feet thick, depth to water table can be disregarded.

Continued.

Local roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable stratified sand at a depth of less than 5 feet; severe hazard leachate flow to ground water.
Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.

Appendix E – Soil Limitations For Recreational Purposes (2).

Soil series and map symbols	Campsites	Picnic grounds, parks, and extensive play areas	Playgrounds and athletic fields	Paths and trails	Golf course fairways
Brookston: Br	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Crosby: CrA	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Severe: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.
Eel: Ee[1]	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Genesee: Ge[1]	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Kokomo: Ko	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Martinsville: MaA, MaB2.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games.	Slight	Slight.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 18 percent: slope hinders use for some games.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent or in severely eroded areas: subject to erosion; clay loam surface of severely eroded areas affects foot trafficability.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use; severely eroded areas affect foot trafficability. Severe where slopes are 12 to 18 percent: slope limits use; severely eroded areas affect foot trafficability.
Milford: Mr	Severe: very poorly drain-	Severe: very poorly drain-	Severe: very poorly drain-	Severe: very poorly drain-	Severe: very poorly drain-

Appendix D – Continued.

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns	Local roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Rensselaer: Re	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable stratified sand at a depth of less than 5 feet; severe hazard leachate flow to ground water.
Shoals: Sh	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Sloan: So	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Westland: Wa	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Whitaker: Wh	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Slight	Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.

[1] If floor of the lagoon is nearly impermeable material at least 2 feet thick, depth to water table can be disregarded.

Appendix E — Soil Limitations For Recreational Purposes (2).

Soil series and map symbols	Campsites	Picnic grounds, parks, and extensive play areas	Playgrounds and athletic fields	Paths and trails	Golf course fairways
Brookston: Br	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Crosby: CrA	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Severe: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.
Eel: Ee[1]	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Genesee: Ge[1]	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Kokomo: Ko	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Martinsville: MaA, MaB2.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games.	Slight	Slight.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 18 percent: slope hinders use for some games.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent or in severely eroded areas: subject to erosion; clay loam surface of severely eroded areas affects foot trafficability.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use; severely eroded areas affect foot trafficability. Severe where slopes are 12 to 18 percent: slope limits use; severely eroded areas affect foot trafficability.
Milford: Mr	Severe: very poorly drain-	Severe: very poorly drain-	Severe: very poorly drain-	Severe: very poorly drain-	Severe: very poorly drain-

	ed; ponding; remains wet for long periods.	ed; ponding; remains wet for long periods.	ed; ponding; remains wet for long periods.	ed; ponding; remains wet for long periods.	ed; ponding; remains wet for long periods; slow permeability.
Ockley: OcA, OcB2, OkC2.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to12 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 12 percent: slope hinders use for some games.	Slight	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use.
Palms: Ps	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuited for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.
Rensselaer: Re	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Shoals: Sh[1]	Severe: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use; somewhat poorly drained.	Severe: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use.	Severe: floods during season of use.
Sloan: So[1]	Severe: flooding; very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: flooding; very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: flooding; very poorly drained; remains wet for long periods.
Westland: We	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Whitaker: Wh	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.

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[1] Frequency and intensity of flooding extremely variable; onsite inspection required.

Appendix F — Other Propert

Soil name and location	Depth	Horizon	Textural class	Size class and particle diameter				
				Very coarse sand to fine sand (2.0 to 0.1 mm)	Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	F (
	Inches							
Kokomo silty clay loam: NW¼ sec. 14, T. 15 N., R. 6 E.	0–9	Ap	Silty clay loam	11.8				
	9–11	A12	Silty clay loam	11.5				
	11–14	B1g	Silty clay loam	9.7				
	14–21	B21tg	Silty clay loam	7.5				
	21–29	B22tg	Silty clay loam	5.6				
	29–38	B23tg	Silty clay loam	3.7				
	38–44	IIB3	Loam	22.2				
	44–60	IIC	Loam	27.6				
Martinsville loam: SW¼ sec. 24, T. 17 N., R. 6 E.	0–8	Ap	Loam	24.1	3.2	3.2	4.2	
	8–13	A2	Silt loam	14.5	.8	1.5	2.9	
	13–25	B21t	Clay loam	15.6	.8	1.0	2.5	
	25–32	B22g	Sandy clay loam	18.5	.3	.2	.6	
	32–40	B23g	Sandy loam	25.4	.2	.2	.2	
	40–50	B3	Sandy loam	31.2	.2	.2	.5	
	50–54	C1	Loamy sand	33.3	.1	.3	.8	
	54–81	C2	Sandy loam	13.8	.1	.2	.3	
Milford silty clay loam: NW¼ sec. 29, T. 17 N., R. 8 E.	0–9	Ap	Silty clay loam	1.3				
	9–12	B21g	Silty clay	.6				
	12–21	B22g	Silty clay	.5				
	21–36	B23g	Silty clay loam	.3				
	36–40	B3	Silty clay loam	.1				
	40–45	C1	Silty clay loam	.3				
	45–61	C2	Silty clay loam	.8				
Sloan silty clay loam: SW¼ sec. 19, T. 16 N., R. 6 E.	0–5	Ap	Loam	25.6				
	5–12	A12	Loam	5.8				
	12–19	B21g	Loam	22.4				
	19–24	B22g	Clay loam	21.7				
	24–37	B23g	Clay loam	23.1				
	37–47	B3g	Clay loam	24.3				
	47–63	C1	Loam	28.7	2.8	3.3	9.2	
	63–72	C1	Sandy loam	71.3	10.0	20.4	26.5	
Whitaker loam: NW¼ sec. 24, T. 17 N., R. 6 E.	0–9	Ap	Loam	35.2	2.9	3.2	10.9	
	9–11	A2	Loam	38.4	3.2	2.0	10.1	
	11–24	B21t	Clay loam	23.8	.8	1.0	5.7	
	24–33	B22t	Loam	32.3	1.2	1.1	7.7	
	33–39	B3t	Sandy loam	59.1	1.9	3.9	16.6	
	39–56	C1	Sandy loam	44.0	.3	7.1	10.2	
	56–64	C2	Sandy loam	43.7		.1	5.5	

Appendix E — Soil Limitations For Recreational Purposes (2).

Soil series and map symbols	Campsites	Picnic grounds, parks, and extensive play areas	Playgrounds and athletic fields	Paths and trails	Golf course fairways
Brookston: Br	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Crosby: CrA	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Severe: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.
Eel: Ee[1]	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Genesee: Ge[1]	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Kokomo: Ko	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Martinsville: MaA, MaB2.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games.	Slight	Slight.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 18 percent: slope hinders use for some games.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent or in severely eroded areas: subject to erosion; clay loam surface of severely eroded areas affects foot trafficability.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use; severely eroded areas affect foot trafficability. Severe where slopes are 12 to 18 percent: slope limits use; severely eroded areas affect foot trafficability.
Milford: Mr	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods; slow permeability.
Ockley: OcA, OcB2, OkC2.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 12 percent: slope hinders use for some games.	Slight	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use.
Palms: Ps	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuited for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.
Rensselaer: Re	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Shoals: Sh[1]	Severe: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use; somewhat poorly drained.	Severe: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use.	Severe: floods during season of use.
Sloan: So[1]	Severe: flooding; very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: flooding; very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: flooding; very poorly drained; remains wet for long periods.
Westland: We	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Whitaker: Wh	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.

[1] Frequency and intensity of flooding extremely variable; onsite inspection required.

Appendix F — Other Propert

Soil name and location	Depth	Horizon	Textural class	Size class and particle diameter			
				Very coarse sand to fine sand (2.0 to 0.1 mm)	Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)
	Inches						
Kokomo silty clay loam: NW¼ sec. 14, T. 15 N., R. 6 E.	0–9	Ap	Silty clay loam	11.8	----	----	----
	9–11	A12	Silty clay loam	11.5	----	----	----
	11–14	B1g	Silty clay loam	9.7	----	----	----
	14–21	B21tg	Silty clay loam	7.5	----	----	----
	21–29	B22tg	Silty clay loam	5.6	----	----	----
	29–38	B23tg	Silty clay loam	3.7	----	----	----
	38–44	IIB3	Loam	22.2	----	----	----
	44–60	IIC	Loam	27.6	----	----	----
Martinsville loam: SW¼ sec. 24, T. 17 N., R. 6 E.	0–8	Ap	Loam	24.1	3.2	3.2	4.2
	8–13	A2	Silt loam	14.5	.8	1.5	2.9
	13–25	B21t	Clay loam	15.6	.8	1.0	2.5
	25–32	B22g	Sandy clay loam	18.5	.3	.2	.6
	32–40	B23g	Sandy loam	25.4	.2	.2	.2
	40–50	B3	Sandy loam	31.2	.2	.2	.5
	50–54	C1	Loamy sand	33.3	.1	.3	.8
	54–81	C2	Sandy loam	13.8	.1	.2	.3
Milford silty clay loam: NW¼ sec. 29, T. 17 N., R. 8 E.	0–9	Ap	Silty clay loam	1.3	----	----	----
	9–12	B21g	Silty clay	.6	----	----	----
	12–21	B22g	Silty clay	.5	----	----	----
	21–36	B23g	Silty clay loam	.3	----	----	----
	36–40	B3	Silty clay loam	.1	----	----	----
	40–45	C1	Silty clay loam	.3	----	----	----
	45–61	C2	Silty clay loam	.8	----	----	----
Sloan silty clay loam: SW¼ sec. 19, T. 16 N., R. 6 E.	0–5	Ap	Loam	25.6	----	----	----
	5–12	A12	Loam	5.8	----	----	----
	12–19	B21g	Loam	22.4	----	----	----
	19–24	B22g	Clay loam	21.7	----	----	----
	24–37	B23g	Clay loam	23.1	----	----	----
	37–47	B3g	Clay loam	24.3	----	----	----
	47–63	C1	Loam	28.7	2.8	3.3	9.2
	63–72	C1	Sandy loam	71.3	10.0	20.4	26.5
Whitaker loam: NW¼ sec. 24, T. 17 N., R. 6 E.	0–9	Ap	Loam	35.2	2.9	3.2	10.9
	9–11	A2	Loam	38.4	3.2	2.0	10.1
	11–24	B21t	Clay loam	23.8	.8	1.0	5.7
	24–33	B22t	Loam	32.3	1.2	1.1	7.7
	33–39	B3t	Sandy loam	59.1	1.9	3.9	16.6
	39–56	C1	Sandy loam	44.0	.3	7.1	10.2
	56–64	C2	Sandy loam	43.7	----	.1	5.5

ies of Selected Soils (2).

Size class and particle diameter						Organic carbon	Reaction (1:1 soil-water suspension)	Extractable	
ine sand (0.25 to .1 mm)	Very fine (0.10 to 0.05 mm)	Silt (0.05 to 0.002 mm)	Clay (less than 0.002 mm)	Total sand (2.0 to 0.05 mm)	Coarse fraction (more than 2.0 mm)			Phosphorus	Potassium
				Percent	*Percent of whole soil*	*Percent*	*pH*	*Pounds per acre*	*Pounds per acre*
...	5.6	49.3	33.3	17.4	...	2.28	6.8	21	225
...	5.5	49.2	33.8	17.0	...	2.11	6.7	24	225
...	4.8	49.1	36.4	14.5	...	.96	6.8	4	180
...	4.2	51.1	37.2	11.7	...	...	6.9	4	225
...	3.3	51.5	39.6	8.9	1.0	...	7.2	2	240
...	2.6	58.9	34.8	6.3	...	...	7.5	2	210
...	10.8	48.6	18.4	33.0	2.2	...	8.0	2	135
...	10.5	41.5	20.4	38.1	5.2	...	8.0	2	105
13.5	15.0	46.0	14.9	39.1	...	...	7.6	25	135
9.3	10.5	62.1	12.9	25.0	...	...	7.7	7	105
11.3	15.0	40.8	28.6	30.6	...	...	7.1	6	195
17.4	33.8	27.0	20.7	52.3	...	...	7.5	10	165
24.8	39.6	18.3	16.7	65.0	...	...	7.6	17	150
30.3	37.2	14.5	17.1	68.4	...	...	7.6	33	150
32.1	41.1	17.3	8.3	74.4	...	...	7.2	10	75
13.2	45.6	38.6	2.0	59.4	...	...	8.4	2	30
...	1.4	58.8	38.5	2.7	...	3.2	7.8	106	180
...	.9	54.5	44.0	1.5	...	2.0	7.3	11	165
...	.7	58.3	40.5	1.2	...	1.0	7.7	6	150
...	.6	65.3	33.8	.9	...	...	7.7	11	225
...	.4	68.1	31.4	.5	...	...	7.8	11	240
...	.7	69.0	30.0	1.0	...	...	7.9	4	240
...	1.2	68.7	29.3	2.0	...	...	8.1	1	165
...	7.7	41.1	25.6	33.3	...	2.0	7.5	58	210
...	7.4	41.5	25.3	33.2	...	2.0	7.7	27	165
...	7.1	44.5	26.0	29.5	...	.99	7.5	14	180
...	6.6	43.3	28.4	28.3	...	.75	7.2	19	180
...	7.3	42.2	27.4	30.4	...	...	7.1	15	180
...	7.5	41.0	27.2	31.8	...	...	7.4	30	195
13.4	6.0	38.7	26.6	34.7	4.0	...	7.5	22	195
14.4	7.6	6.4	14.7	78.9	12.6	...	7.8	8	60
18.2	7.6	44.5	12.7	42.8	...	...	7.1	12	90
23.0	7.0	36.7	17.9	45.4	...	...	6.8	4	105
16.3	5.9	38.3	32.0	29.7	...	...	5.8	4	195
22.3	7.0	35.1	25.6	39.3	...	...	6.7	2	180
36.7	5.0	16.1	19.8	64.1	...	...	6.8	3	165
16.4	8.0	32.7	15.3	52.0	10.0	...	8.2	3	105
38.1	26.9	24.3	5.1	70.6	...	...	8.4	4	45

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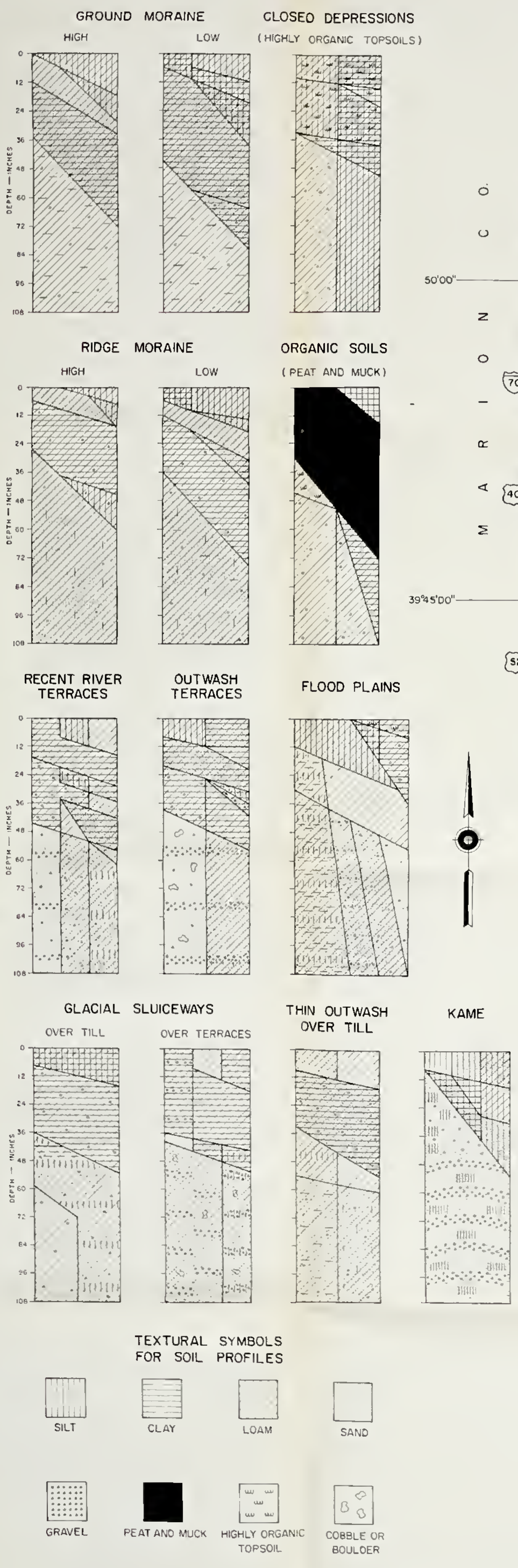
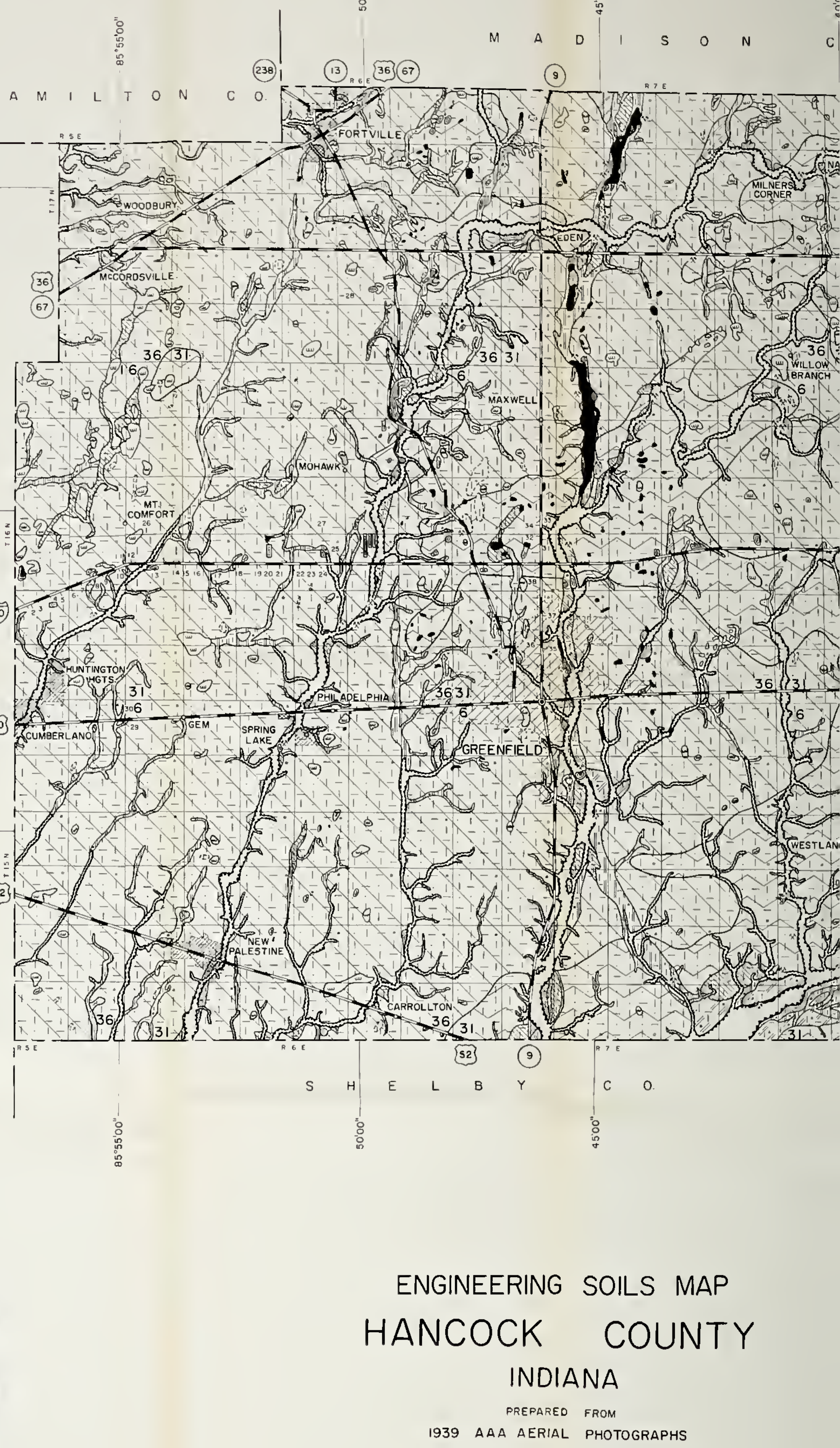
Appendix F — Other Properties of Selected Soils (2).

Soil name and location	Depth	Horizon	Textural class	Size class and particle diameter				Size class and particle diameter						Organic carbon	Reaction (1:1 soil-water suspension)	Extractable	
				Very coarse sand to fine sand (2.0 to 0.1 mm)	Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	Fine sand (0.25 to 0.1 mm)	Very fine (0.10 to 0.05 mm)	Silt (0.05 to 0.002 mm)	Clay (less than 0.002 mm)	Total sand (2.0 to 0.05 mm)	Coarse fraction (more than 2.0 mm)			Phosphorus	Potassium
	Inches											*Percent*	*Percent of whole soil*	*Percent*	*pH*	*Pounds per acre*	*Pounds per acre*
Kokomo silty clay loam: NW¼ sec. 14, T. 15 N., R. 6 E.	0–9	Ap	Silty clay loam	11.8					5.6	49.3	33.3	17.4		2.28	6.8	21	225
	9–11	A12	Silty clay loam	11.5					5.5	49.2	33.8	17.0		2.11	6.7	24	225
	11–14	B1g	Silty clay loam	9.7					4.8	49.1	36.4	14.5		.96	6.8	4	180
	14–21	B21tg	Silty clay loam	7.5					4.2	51.1	37.2	11.7			6.9	4	225
	21–29	B22tg	Silty clay loam	5.6					3.3	51.5	39.6	8.9	1.0		7.2	2	240
	29–38	B23tg	Silty clay loam	3.7					2.6	58.9	34.8	6.3			7.5	2	210
	38–44	IIB3	Loam	22.2					10.8	48.6	18.4	33.0	2.2		8.0	2	135
	44–60	IIC	Loam	27.6					10.5	41.5	20.4	38.1	5.2		8.0	2	105
Martinsville loam: SW¼ sec. 24, T. 17 N., R. 6 E.	0–8	Ap	Loam	24.1	3.2	3.2	4.2	13.5	15.0	46.0	14.9	39.1			7.6	25	135
	8–13	A2	Silt loam	14.5	.8	1.5	2.9	9.3	10.5	62.1	12.9	25.0			7.7	7	105
	13–25	B21t	Clay loam	15.6	.8	1.0	2.5	11.3	15.0	40.8	28.6	30.6			7.1	6	195
	25–32	B22g	Sandy clay loam	18.5	.3	.2	.6	17.4	33.8	27.0	20.7	52.3			7.5	10	165
	32–40	B23g	Sandy loam	25.4	.2	.2	.2	24.8	39.6	18.3	16.7	65.0			7.6	17	150
	40–50	B3	Sandy loam	31.2	.2	.2	.5	30.3	37.2	14.5	17.1	68.4			7.6	33	150
	50–54	C1	Loamy sand	33.3	.1	.3	.8	32.1	41.1	17.3	8.3	74.4			7.2	10	75
	54–81	C2	Sandy loam	13.8	.1	.2	.3	13.2	45.6	38.6	2.0	59.4			8.4	2	30
Milford silty clay loam: NW¼ sec. 29, T. 17 N., R. 8 E.	0–9	Ap	Silty clay loam	1.3					1.4	58.8	38.5	2.7		3.2	7.8	106	180
	9–12	B21g	Silty clay	.6					.9	54.5	44.0	1.5		2.0	7.3	11	165
	12–21	B22g	Silty clay	.5					.7	58.3	40.5	1.2		1.0	7.7	6	150
	21–36	B23g	Silty clay loam	.3					.6	65.3	33.8	.9			7.7	11	225
	36–40	B3	Silty clay loam	.1					.4	68.1	31.4	.5			7.8	11	240
	40–45	C1	Silty clay loam	.3					.7	69.0	30.0	1.0			7.9	4	240
	45–61	C2	Silty clay loam	.8					1.2	68.7	29.3	2.0			8.1	1	165
Sloan silty clay loam: SW¼ sec. 19, T. 16 N., R. 6 E.	0–5	Ap	Loam	25.6					7.7	41.1	25.6	33.3		2.0	7.5	58	210
	5–12	A12	Loam	5.8					7.4	41.5	25.3	33.2		2.0	7.7	27	165
	12–19	B21g	Loam	22.4					7.1	44.5	26.0	29.5		.99	7.5	14	180
	19–24	B22g	Clay loam	21.7					6.6	43.3	28.4	28.3		.75	7.2	19	180
	24–37	B23g	Clay loam	23.1					7.3	42.2	27.4	30.4			7.1	15	180
	37–47	B3g	Clay loam	24.3					7.5	41.0	27.2	31.8			7.4	30	195
	47–63	C1	Loam	28.7	2.8	3.3	9.2	13.4	6.0	38.7	26.6	34.7	4.0		7.5	22	195
	63–72	C1	Sandy loam	71.3	10.0	20.4	26.5	14.4	7.6	6.4	14.7	78.9	12.6		7.8	8	60
Whitaker loam: NW¼ sec. 24, T. 17 N., R. 6 E.	0–9	Ap	Loam	35.2	2.9	3.2	10.9	18.2	7.6	44.5	12.7	42.8			7.1	12	90
	9–11	A2	Loam	38.4	3.2	2.0	10.1	23.0	7.0	36.7	17.9	45.4			6.8	4	105
	11–24	B21t	Clay loam	23.8	.8	1.0	5.7	16.3	5.9	38.3	32.0	29.7			5.8	4	195
	24–33	B22t	Loam	32.3	1.2	1.1	7.7	22.3	7.0	35.1	25.6	39.3			6.7	2	180
	33–39	B3t	Sandy loam	59.1	1.9	3.9	16.6	36.7	5.0	16.1	19.8	64.1			6.8	3	165
	39–56	C1	Sandy loam	44.0	.3	7.1	10.2	16.4	8.0	32.7	15.3	52.0	10.0		8.2	3	105
	56–64	C2	Sandy loam	43.7		.1	5.5	38.1	26.9	24.3	5.1	70.6			8.4	4	45

GENERAL SOIL PROFILES



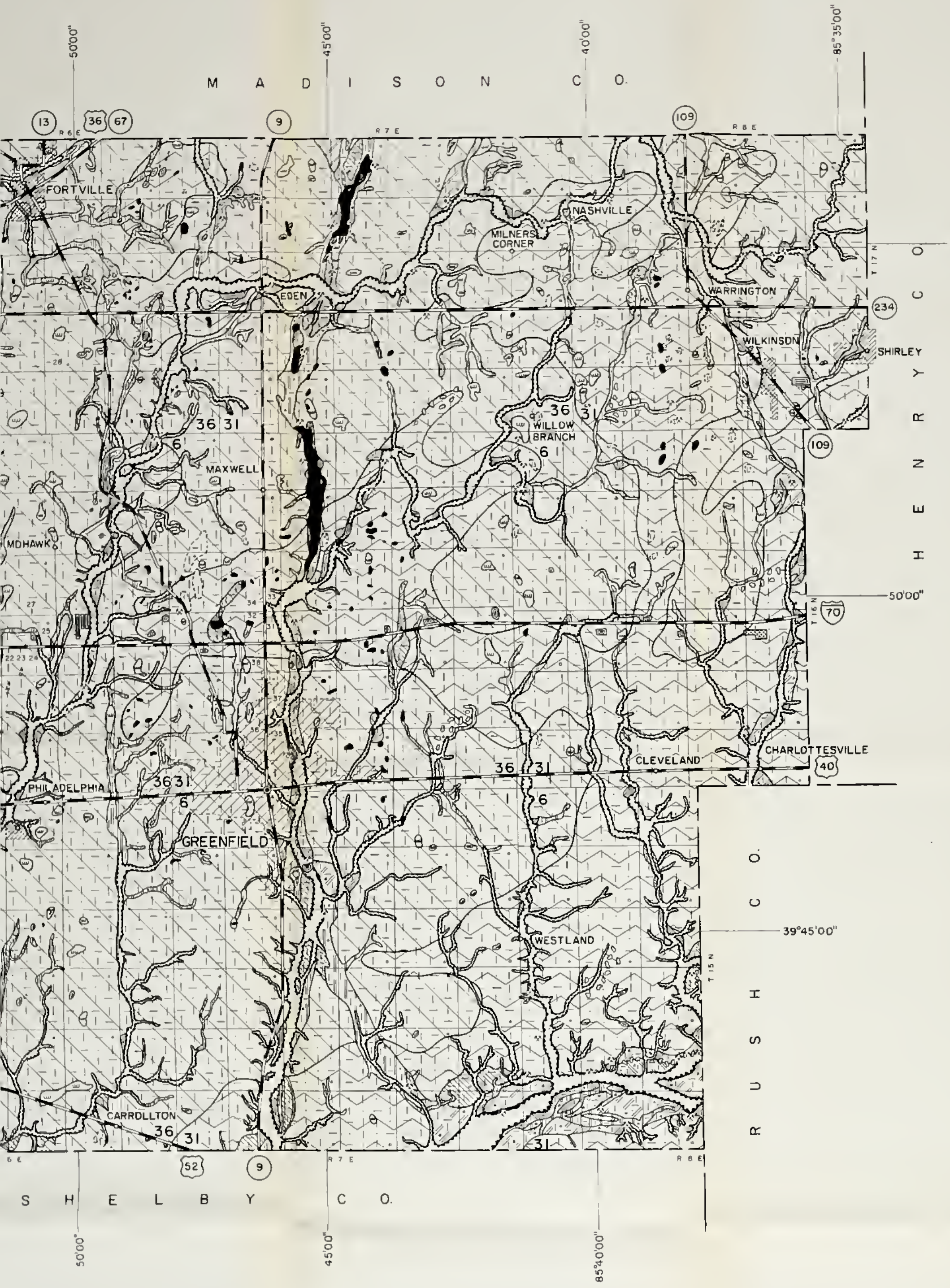


ENGINEERING SOILS MAP
HANCOCK COUNTY
INDIANA

PREPARED FROM
1939 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1983

SCALE OF MILES
3/4 1/2 1/4 0 1 2 3 4

PREPARED UNDER THE SUPERVISION OF E M GEFELL AND R D MILES



LEGEND

PARENT MATERIALS

(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- GROUND MORAINE
- RIDGE MORAINE
- OUTWASH TERRACE
- RECENT RIVER TERRACE
- FLOOD PLAIN
- GLACIAL SLUICEWAY
- THIN OUTWASH OVER TILL
- WATER REWORKED TILL
- KAME AND ESKER

MISCELLANEOUS

- GRAVEL PIT
- LAKE OR POND
- PEAT AND MUCK
- URBAN AREAS
- HIGHLY ORGANIC TOPSOIL
- BOULDER
- BORING SITES
- CUT AND FILL

TEXTURAL SYMBOLS

(SUPERIMPOSED ON PARENT MATERIAL TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

ENGINEERING SOILS MAP
HANCOCK COUNTY
INDIANA

PREPARED FROM
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1983

SCALE OF MILES
1 ¾ ½ ¼ 0 1 2 3 4

DRAWN BY E. P. H CHEN

COVER DESIGN BY ALDO GIORGINI